



# ecology and environment, inc.

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International Specialists in the Environment

SITE:	BIG RIVER MINE
ID:	MOD981126899
BREAK:	1.7
OTHER:	AR
5-17-88	

07CR

## MEMORANDUM

TO: Paul Doherty, RPO  
THRU: Philip Dula, AFITOM  
FROM: Bob Overfelt, E & E/FIT  
DATE: May 17, 1988

SUBJECT: Recommendations and HRS considerations for the Big River Mine  
Tailing site in Desloge, Missouri  
TDD #F-07-8711-039 PAN #FM00616PA  
Site #Y60 Project #001  
Superfund Contact: Gene Gunn

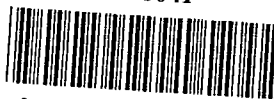
The 600-acre Big River Mine Tailings site was for 30 years the repository for mine tailings containing significant quantities of lead, cadmium, and zinc. The site is bounded on three sides by a horseshoe bend of the Big River. This site presents several complex problems including water and wind erosion, and the possibility of leachate from the on-site landfill releasing lead (Pb) and other heavy metals to the ground water and surface water.

Past investigations have documented huge influxes of mine tailings into the Big River. Severe water erosion has changed the benthic zone of the river. The river bottom is covered with a layer of mine tailings where it abuts the site and for several miles downstream. The physical state and chemical characteristics of the river bottom have been altered, and elevated Pb levels have been reported in bottom-feeding biota.

Wind erosion and airborne dust is also a major problem at this site. In certain areas mine tailings are entering the river via wind erosion. The tailings material is dolomitic sand and silt that is easily suspended in the air. During the reconnaissance this problem was especially apparent: winds were very strong and created a suspended particulate plume that traveled at least a mile over the town of Desloge. Inhalation of this dust, which contains, lead, cadmium, and zinc, could be a potential health hazard.

The St. Francois County Environmental Corporation landfill is located on the site. The primary environmental concern about operating the landfill in the lead, cadmium and zinc-laden mine tailings is the acidic

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nature of typical landfill leachate. The potential for leachate from the landfill to transport these heavy metals into the ground water and surface water sources is high. Monitoring wells were installed around the landfill in 1987. Samples have been taken from these wells but analytical results have not been received.

St. Joe Minerals Corporation and the Desloge Tailings Task Force have made a genuine, concerted effort to stabilize the tailings pile. This effort continues. Because this site is so immense, more stabilization work is required. Further work by St. Joe Minerals and the Desloge Tailings Task Force to maintain and work toward stabilization should be encouraged. Their maintenance program has prevented the occurrence of catastrophic erosional events since 1985. This is a notable accomplishment, considering the relative instability and size of the pile. However, the wind erosion factor and specific concerns about the on-site landfill have not been sufficiently evaluated or fully characterized.

An HRS score of 58.4 has been calculated for the Big River Mine Tailings site. Because of the nature of the tailings material, its location on the Big River, and the on-site landfill, all contamination routes are a major concern. Observed releases were scored for the surface water and air routes with scores of 10.9 and 55.4, respectively. The ground water route score is 83.8. A score of 50 was calculated for the direct contact route.

The FIT recommends that a site inspection be performed to establish whether wind erosion (with its related suspended particulate problem) is creating a health hazard and to determine whether the landfill is releasing leachate that could potentially contaminate the ground water and surface water. Hi-vol air monitoring should be implemented to determine total suspended particulates and lead content in ambient air on site, in Desloge, and at a background location. The existing monitoring wells should be sampled to determine whether heavy metals and landfill leachate have contaminated the ground water. According to Missouri Department of Natural Resources officials, a spring exists on site that empties into the Big River. If so, samples should be collected from the point of entry. This work should be considered a high priority.

#### Ground Water Route

Several communities in the site area rely on the Bonnetterre and Lamotte aquifers for potable water. The Bonnetterre Formation contained the lead deposits (Galena PbS) that were mined. Because Pb has limited solubility in alkaline water, high concentrations of Pb in the water are generally not a problem (Ref. 25). Because the aquifer is located in a

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Recommendations and HRS Considerations  
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dolomitic formation, the ground water is alkaline. Therefore, the potential for Pb-contamination of the ground water is reduced significantly.

Although there is justified concern about having the St. Francois County Landfill located in the tailings pile. Landfill leachate tends to be acidic. If the landfill leached a considerable amount of acidic material then this could release the Pb contained in the mine tailings. Because the permeability and porosity of the tailings are high this potentially released Pb could migrate into the ground water and then into the Big River. The landfill creates potential for ground water and surface water contamination.

#### Surface Water Route

Because the Big River Mine Tailings site is adjacent to the Big River the potential for surface water contamination exists. The drainage from the site flows directly into the Big River. Results of studies on the chemical characteristics of the water in Big River show that the Pb content is elevated around mine tailings piles and downstream when compared to background samples. Most samples analyzed were below the 50 ug/l Maximum Contaminant Level, which is consistent with the low solubility of Pb in alkaline water. Though the benthic zone of the Big River is lined with mine tailings, the high pH of the water controls Pb solubility.

#### Air Route

The tailings at the Big River Mine Tailings site are a ground, dolomitic powder containing lead, cadmium, and zinc. The tailings are easily airborne and carried off site. This creates a problem with total suspended particulates as well as lead-laden particulates that also are suspended in this material (Photo C-1, Appendix C).

#### Receptors

The principal receptors of the lead contamination from the heavy metal contamination are:

- o people who breathe the lead-laden suspended particulates. Approximately 4,000 people in Desloge are located within a mile of the site;
- o bottom-feeding fish of the Big River; and
- o those who consume the contaminated bottom-feeding fish of the Big River.

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**Direct Contact**

The employees of the on-site landfill are constantly exposed to the mine tailings while at work. Also, many people use the tailings piles for recreational purposes such as riding all-terrain vehicles. This activity creates dust and increases wind erosion.

Preliminary Assessment  
Big River Mine Tailings  
Desloge, St. Francois County, Missouri  
TDD #F-07-8711-039 PAN #FM00616PA  
Site #Y60 Project #001  
Submitted to: Paul E. Doherty, RPO  
Task Leader: Robert Overfelt, E & E/FIT  
Superfund Contact: Gene Gunn  
Date: May 17, 1988

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## SECTION 1: INTRODUCTION

The Ecology and Environment, Inc., Field Investigation Team (E & E/FIT) was tasked by the U.S. Environmental Protection Agency (EPA) to conduct a Preliminary Assessment (PA) of the Big River Mine Tailings site near Desloge, Missouri. The tasks authorized under Technical Directive Document (TDD) #F-07-8711-039 were to gather and review background information, conduct a site reconnaissance, prepare a preliminary assessment report, and submit an updated EPA Preliminary Assessment Form 2070-12.

A site reconnaissance was conducted by E & E/FIT member Robert Overfelt on January 25, 1988. Site conditions were documented with photographs (Appendix D).

The site was brought to the attention of the Region VII EPA because mine tailings containing lead and other heavy metals were entering the Big River due to erosion. A high potential for heavy metals contamination of the Big River exists at this site.



## SECTION 2: SITE DESCRIPTION AND HISTORY

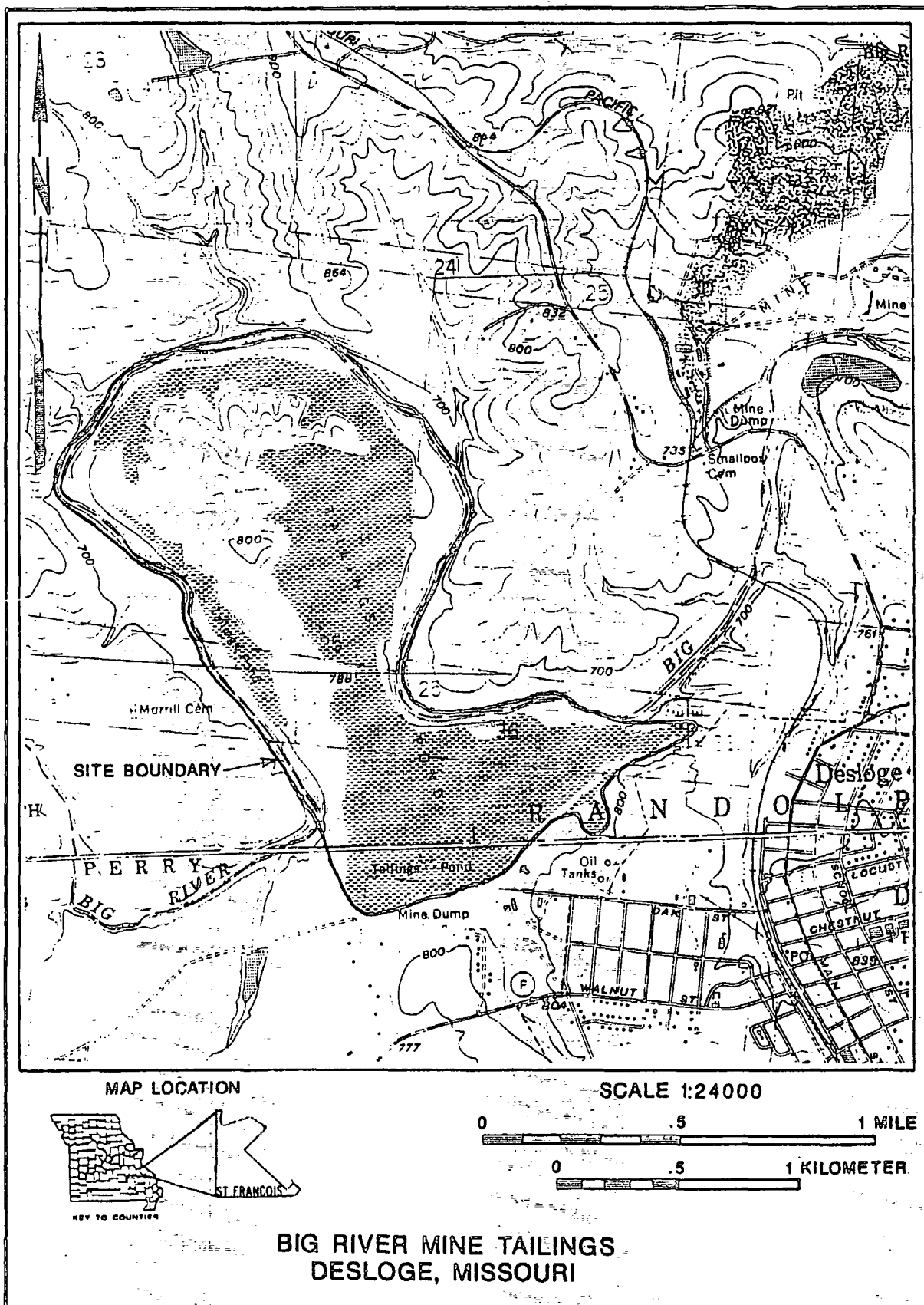
### 2.1 SITE DESCRIPTION

The Big River Mine Tailings site is located in St. Francois County approximately one-half mile northwest of Desloge, Missouri (Figure 1). This area of southeast Missouri is known as the "Old Lead Belt" and was formerly a major producer of lead. The coordinates of the approximate center of the site are 37° 53' 11".4 north latitude and 90° 33' 00".0 west longitude (Ref. 1).

The Big River Mine Tailings site covers approximately 600 acres (Figure 2). It consists mainly of mine tailings ranging from 0 to 100 feet deep (Ref. 2). A sanitary landfill and landfill office are located on the south end of the site. The landfill is operated by the St. Francois County Environmental Corporation which has a state permit to fill approximately 60 acres (Ref. 3). There are six monitoring wells installed around the landfill and the well logs are included as Appendix B. The majority of the site is situated within a horseshoe meander of the Big River (Figure 2).

### 2.2 SITE HISTORY

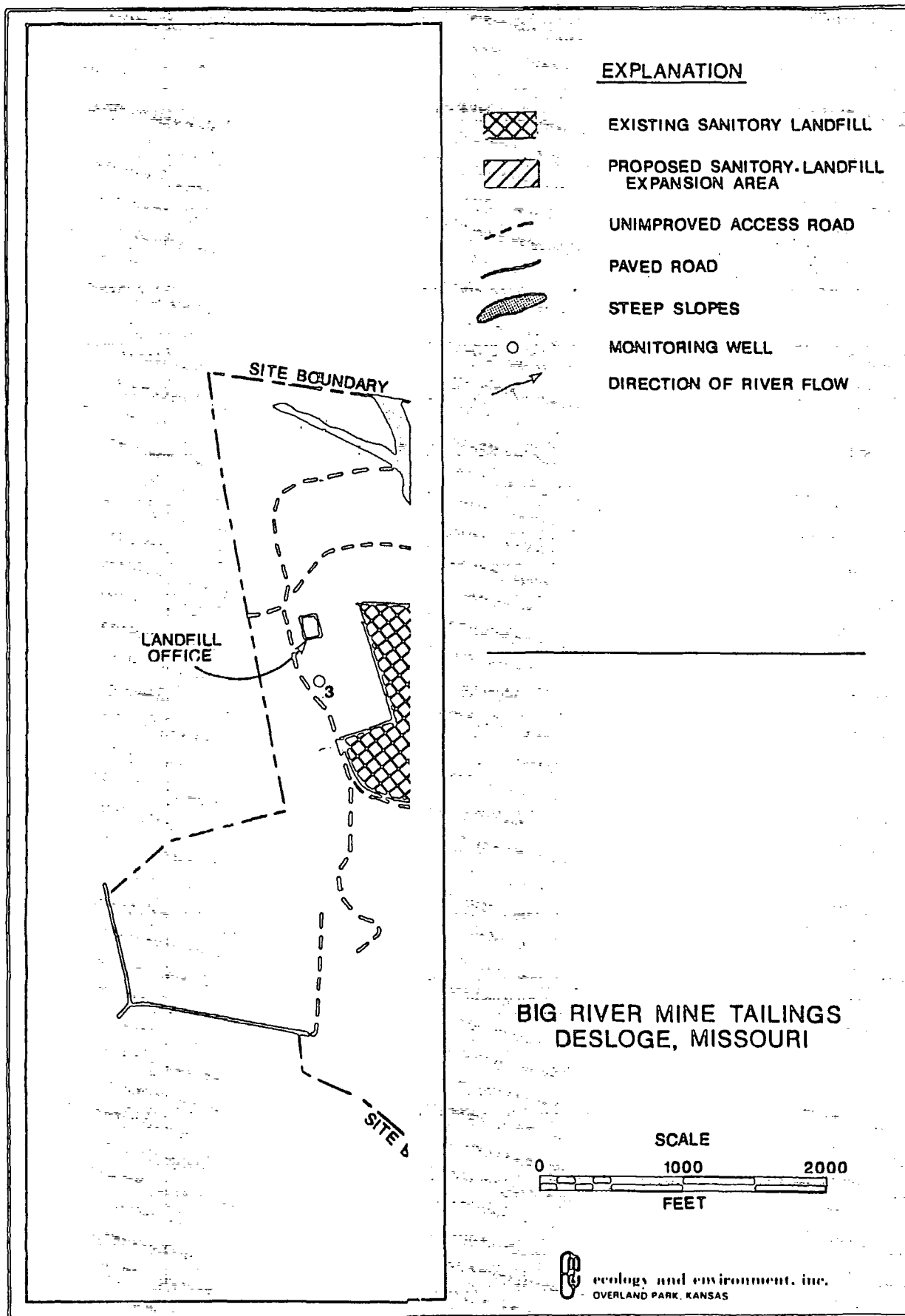
The 600-acre Big River Mine Tailings site is the result of 30 years (1929 to 1958) of stockpiling lead mining wastes from a mill which was located just west of the Desloge City limits (Ref. 4). After processing, the tailings were transported to the site via a slurry pipeline. Tailings ponds were formed when the tailings settled out. The St. Joe Minerals Corporation owned the tailings site until 1972 when it donated the majority of the site, 502 acres, to St. Francois County (Ref. 4). Approximately 100 acres, which is located directly east of the present-day landfill, is still owned by St. Joe Minerals. An immense mine tailings pile, estimated between 75 and 125 feet high, is located on the St. Joe Minerals property (Ref. 3) (Figure 3).



WASTE SITE TRACKING #: MO0618  
PREPARED BY: R. OVERFELT

ECOLOGY & ENVIRONMENT FIT MARCH 1988  
SOURCE: USGS 7.5' BONNE TERRE  
& FLAT RIVER, MO QUADS. 1982

FIGURE 1-1: SITE LOCATION



WASTE SITE TRACKING NO.: MO0816  
PREPARED BY: C. WILLIAMS

FIT APRIL 1988  
SOURCE: REF. 10

FIGURE 2: SITE MAP

After acquisition of the 502 acres, St. Francois County leased the land to the St. Francois County Environmental Corporation (SFCEC) (Ref. 5). In 1973 the non-profit SFCEC established a sanitary landfill on approximately 60 acres of the southwest section of the mine tailings pile (Ref. 2 and 3). Bryant AuBuchon, manager of the SFCEC landfill, stated that the landfill accepts typical residential refuse and debris and that the refuse is not separated into specified cells (Ref. 5). Hudwalker and Associates, Inc., a consulting engineering firm located in Farmington, Missouri, has administered landfill operations and maintenance of the tailings pile for the last three years (Ref. 3).

Marvin Hudwalker of Hudwalker and Associates, Inc., was present during the reconnaissance. He stated that mine tailings were used as daily cover on the trash and that when a cell is filled a one-yard thick clay cover is applied and grass is planted. During the reconnaissance, the filled landfill cells were noted to have a continuous cover and the area was relatively clean.

A review of the Missouri Department of Natural Resources (MDNR) files regarding the landfill revealed that the landfill operation was very inadequate before Hudwalker and Associates took over administration. The facility was cited numerous times for various violations. Photographs from repeated inspections of the landfill depict large amounts of refuse with no cap or vegetated cover (Ref. 9).

According to a 1977 University of Missouri-Columbia report, the area experienced a severe storm event involving the section of the tailings pile known as Gap "A" which is located adjacent to the Big River on the southeast side of the horse-shoe bend (Figure 3). This portion of the mine tailings pile became supersaturated and collapsed, releasing its contents into the Big River (Appendix D, Photo C-3). Although the exact quantity of mine tailings that washed into the river is not known, estimates suggest that the quantity may have been as much as 50,000 cubic yards (Ref. 3) (Figure 3). When the MDNR discovered this catastrophic event, they requested that the Environmental Protection Agency Surveillance and Analysis team (SVAN) conduct an extensive investigation of the Big River. The SVAN conducted this survey in late 1977, and the general

findings, based on aquatic population density and diversity, were that the Big River was degraded by the mine tailings that entered the river. The degradation was mainly the result of physical changes in the benthic zone of the river rather than chemical toxicity of the river water (Ref. 2).

In 1980 the Missouri Department of Conservation submitted evidence that some fish sampled downstream from the tailings pile contained elevated levels of lead (Ref. 2). This report concluded that the high concentrations of lead were found in the edible tissue of fish found in the Big River downstream from the location where mine tailings had entered the river during the rupture in 1977. The highest concentration found, 1.30 ppm, was found in sample nine from four golden redhorse fish collected immediately downstream from the collapsed Desloge tailings pile (Ref. 6). The World Health Organizations (WHO) dietary limit for lead is 0.3 ppm (Ref. 6).

As a result of these findings, the state of Missouri issued a press release cautioning local residents not to eat bottom-feeders taken from a 50-mile stretch of the Big River from the city of Leadwood (near the Desloge tailings pile) downstream to Washington State Park (Ref. 7). Since 1980 numerous research projects have focused on the impact of the mine tailings piles in the Old Lead Belt on the Big River. Results of various studies of the mine tailings and their effect on the Big River will be presented in Section 3.

By December 1981 St. Joe Minerals Corporation, under a cooperative agreement with the state of Missouri, began remedial action on the pile in an effort to fill the erosional gaps and stabilize the pile (Ref. 8). Many smaller erosional events have been documented since the massive release in 1977. Section 2.3 will detail the past and present erosional problems as well as the efforts undertaken to stabilize the piles.

In the spring of 1985 the Desloge Tailings Task Force was organized to deal with the existing problems of the Desloge Mine Tailings site. The Task Force, organized by St. Joe Minerals, consisted of representatives from St. Joe Minerals, the landfill, and MDNR, as well as local

officials and others. Specific activities of the Task Force are detailed in Section 2.3. The Task Force focused on three primary objectives:

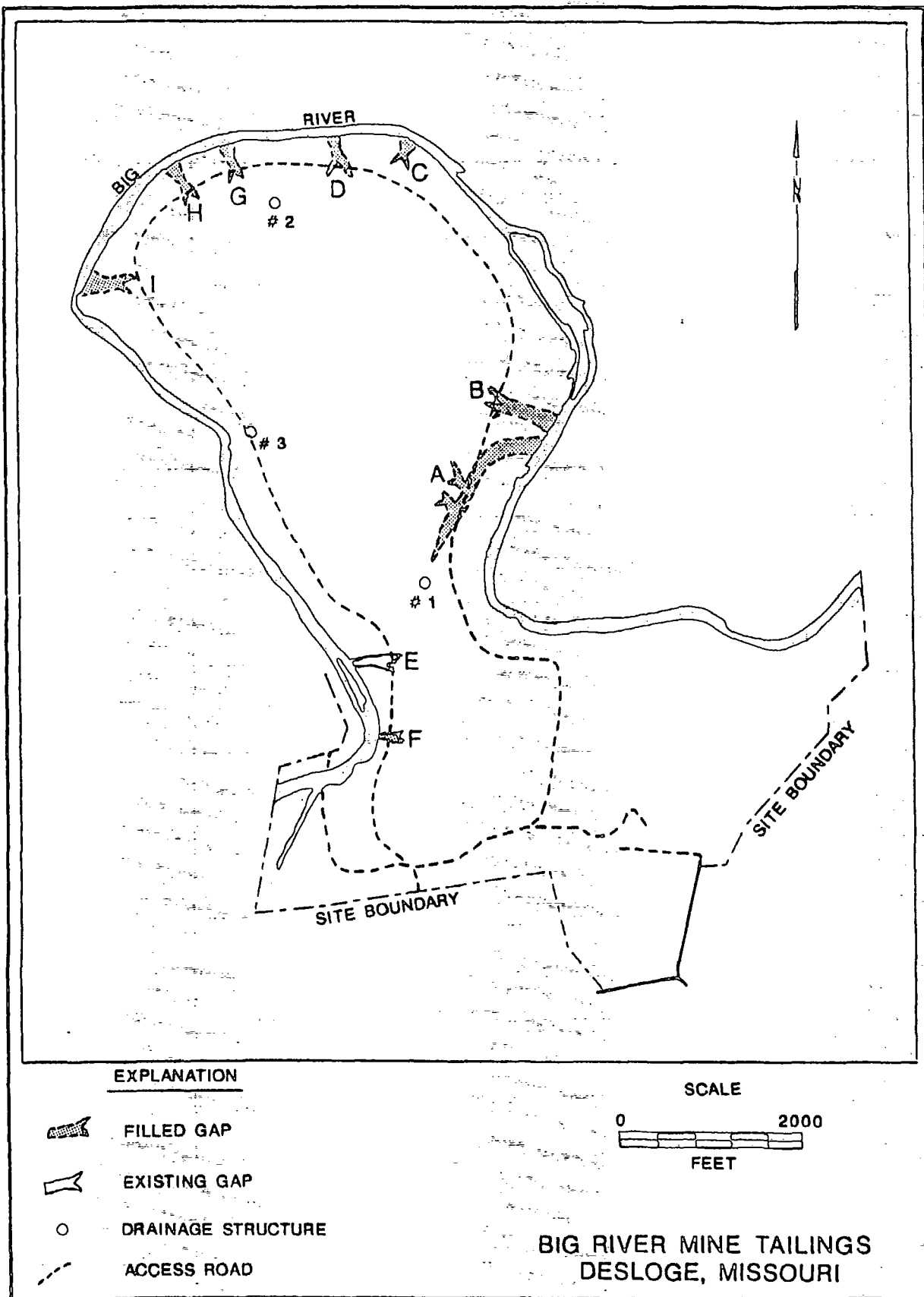
1. Provide adequate site supervision to ensure proper repair and maintenance.
2. Develop and implement short-term measures to stabilize the site.
3. Develop a long-term stabilization plan for the site.

Landfill authorities requested a permit from the state of Missouri to expand operation into 200 additional acres of the tailings pile. In January 1987, as a result of this proposed expansion, the MDNR requested that six monitoring wells be installed around the existing landfill to determine whether the ground water contained significant quantities of landfill leachate (Ref. 3) (Figure 2). The well logs for these six monitoring wells are included as Appendix B. Water samples have been taken from the wells but the results of the analyses have not been received.

### 2.3 STABILIZATION EFFORTS

After the massive release of mine tailings into the Big River in 1977, efforts to stabilize this mine tailings pile were initiated. A number of remedial efforts have been accomplished. The reports from several agencies detail the problems that exist at the site and present solutions to these problems.

A comprehensive report prepared in 1980 for MDNR by the University of Missouri Columbia (UMC) College of Engineering characterizes the major environmental concerns at the site including water and wind erosion and the apparent hazard of constructing a landfill in the tailings pile. The UMC investigation concluded that the tailings pile contained numerous points where tailings are entering the Big River due to water erosion. The UMC team designated six gaps, which were labeled alphabetically around the pile starting on the southeast side (Figure 3). Erosional gaps G, H, and I developed after the report was completed and have been labeled as they occurred.



WASTE SITE TRACKING #: MO0816  
PREPARED BY: R. OVERFELT

ECOLOGY & ENVIRONMENT APRIL 1988  
SOURCE: REFERENCE 4

FIGURE 3: MAJOR EROSIONAL FEATURES

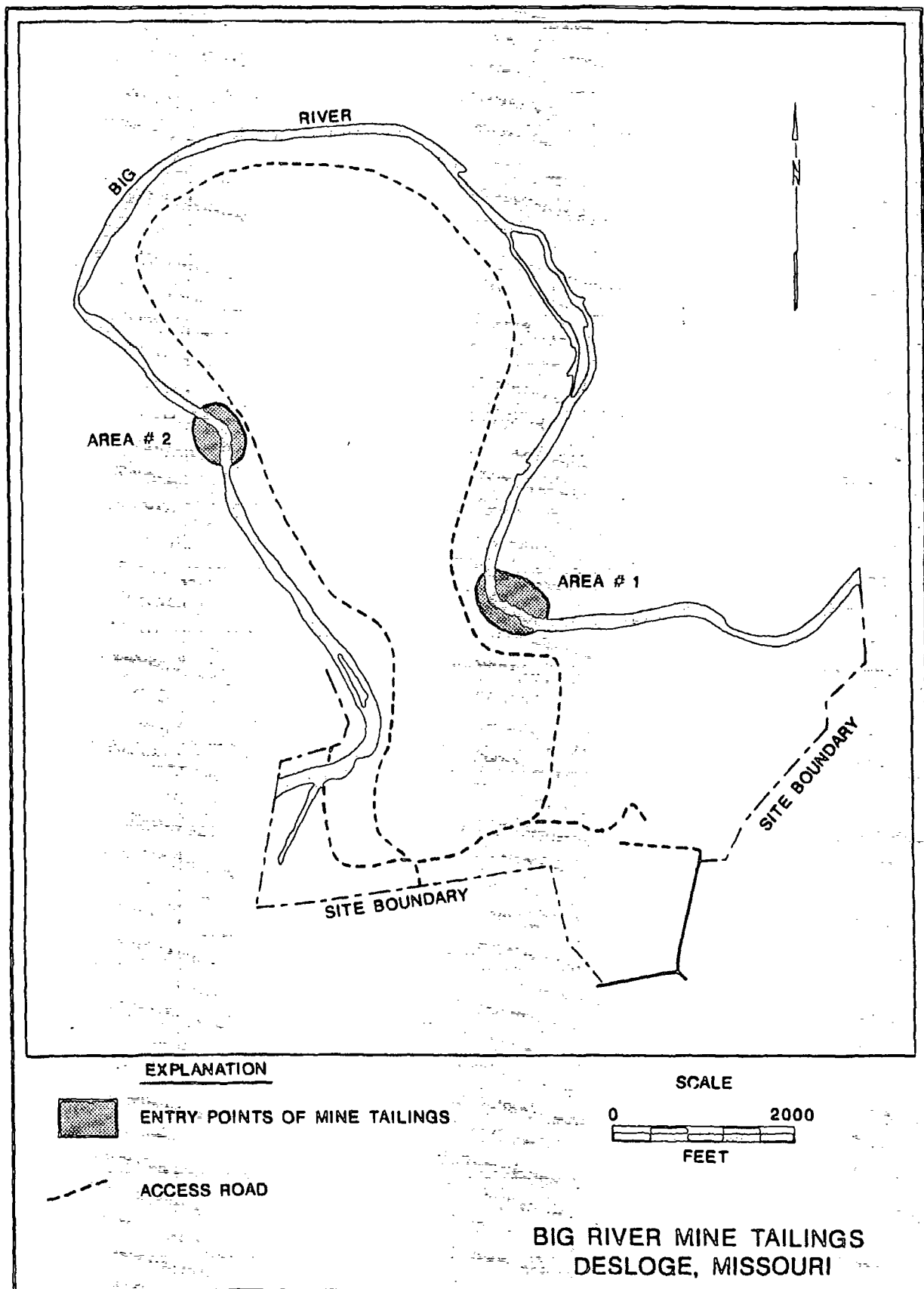
The original drainage structures placed by the mining company are illustrated in Photo C-14 (Appendix D). These concrete drainage structures were constructed to drain the water from off the tailings pile. During the E & E/FIT site reconnaissance, it was noted that drainage structure #1 near Gap A was totally collapsed and was no longer functional. According to the UMC report, drainage structure #1 became blocked and this blockage led to the massive erosion which occurred in 1977 at Gaps A and B. The UMC report recommended that the major erosional gaps be filled with a suitable fill material and the area reshaped to reduce further erosion. Further, the report suggested that the drainage structure located near Gap A be altered to minimize the chance for overflow (Ref. 4).

Wind erosion and the associated blowing of lead-laden dust is also a major concern (Appendix D, Photo C-1). There the tailings pile reaches the river bank in two areas (Figure 4). During the FIT reconnaissance, it was noted areas #1 and #2 that the wind was eroding the tailings over the steep incline. As tailings accumulate, and their angle of repose is exceeded, they collapse and fall into the river (Photo C-2). The major problem at area #2 is the river undercutting the bank, which eventually could lead to a collapse of the tailings in the area into the river (Photos C-12, C-13). Wind erosion is generally from west to east, which produces a continuous movement of the tailings toward the east. Because the tailings are a very fine, dolomitic sand or silt sufficient wind velocity creates a tailings dust cloud. During the site reconnaissance this occurrence was observed to be a serious problem (Photo C-1). A dust plume originating from the site was transporting dust at least one mile to the southeast. Wind speeds on that day included gusts up to 35 miles per hour.

The UMC report recommended that a study be undertaken to assess the possibility for plant growth to be established on the pile to control wind erosion. Plant life is very difficult to establish in this environment for several reasons:

- o A serious nutrient deficiency exists in the tailings;
- o Wind erosion prevents establishment of seedlings;
- o Moisture cannot be retained, especially on the slopes, due to the porous nature of the tailings; and
- o The lead content of the tailings may cause plant sterilization, preventing reseeding by existing plants.





WASTE SITE TRACKING #: MO0816  
PREPARED BY: R. OVERFELT

ECOLOGY & ENVIRONMENT APRIL 1988  
SOURCE: REFERENCE 4

FIGURE 4: OBSERVED ENTRY POINTS OF MINE TAILINGS TO BIG RIVER

Because of these deleterious conditions, natural plant growth on the pile is almost non-existent. This experimentation was suggested as an attempt to establish a method for maintaining a vegetative cover.

The UMC report considers the landfill on site to be a serious potential problem. The liquid runoff (leachate) that results from a landfill is typically low pH and contains large quantities of organic material. If these conditions exist it is very possible that heavy metals could be leached from the tailings and transported to the Big River. In the UMC report, tests were conducted by extracting mine tailings with nitric acid, distilled water, and ethylenediaminetetraacetic acid (EDTA). The nitric acid extraction represents total quantity of metals in the tailings. The distilled water extraction represents what is released by the movement of rain water through the tailings. The EDTA extraction represents the potential for extraction by landfill leachate (Table 1). Metals that are extracted by landfill leachate would also be chemically bound by organics and might remain in solution after entering a body of water such as the Big River. During the reconnaissance the area where landfiling was complete and soil cover was applied was observed to be much more stable than the adjacent mines tailings. However, the benefits of soil cover are offset by the potential for landfill leachate to release lead and other metals from the tailings (Ref. 4).

These three problems of water erosion, wind erosion, and the landfill are considered the primary concerns at the Desologe tailings pile. When the UMC report was submitted in 1980, no remedial action had begun. However, St. Joe Minerals Corporation began remedial activities in 1981 that are continuing.

In December 1981 St. Joe Minerals Corporation began filling Gaps A, B, C, and D. This remedial action was completed in January 1982 (Ref. 8). C. G. Mattson, Project Manager, St. Joe Minerals Corporation, provided a summary of the remedial activity and maintenance performed since the initial work on Gaps A, B, C and D.

Inspections have been performed at least once per month from December 1981 to the present by St. Joe Minerals and/or the engineer for the landfill. Inspections also are made after or during heavy rainfall

Table 1

## Metal Analyses of Tailings

Big River Mine Tailings Desloge, Missouri

University of Missouri-Columbia College of Engineering

/g dry)			Sand (ug/g dry)		
Water	EDTA	HNO <sub>3</sub>	Water	EDTA	HNO <sub>3</sub>
20	2,200	2,400	26	720	850
N.D.	3.2	14	N.D.	5.8	25
3.4	220	680	14	230	1,000

N.D. is not detected.

Water: Represents rainfall through tailings.

EDTA: Ethylenediaminetetraacetic acid and represents landfill leachate through tailings.

HNO<sub>3</sub>: Represents total metal content in tailings.

: Ref. 4

The inspections consist of confirming that all drainage structures are functional and that no observable defects have occurred in the ing berm.

In April 1983 two small gaps, designated Gaps G and H were formed. Unusually heavy rainfall overtopped the retaining berm (Photo C-8). Gaps were filled and a 22-inch steel pipe drainage structure was installed in each. In October 1984, 1,500 feet of fence was placed along base of the chat pile and the area north of the fence was seeded, mulched, and covered with straw mulch. This fence was built to force a dune formed by a wind fence placed in 1980.

In April 1985 Gap "I" was formed when heavy rainfall topped the retaining berm. The gap was filled and a 22-inch steep pipe drainage structure was established. At the same time, 2,000 feet of snow fence was placed in the area of the break to build up the retaining berm with wind-blown material. The open channel spillway cut that drains the pond area was deepened and a diversion ditch was cut across natural ground to keep water from flowing into the Gap "I" area (Photo C-10 and C-11). A diversion dike was built through natural ground so that water diverted by the landfill operations would not flow into Gap "E" (Photos C-15, C-16 and C-17).

In October 1985, the approximately 20 acres of tailings that comprise the major portion of the Gap "I" drainage area were fertilized and seeded. During the FIT reconnaissance it was apparent that the vegetation in this particular area was growing well and had stabilized the area. It should be noted that this area is flat and stable relative to other steep sloping, dune-like areas that also exist on the tailings pile (Photo C-9).

In March 1986, 10,000 Black Locust trees were planted on the Desloge tailings area, some 7,500 of them were planted in the Gap "I" drainage area that was sown in October 1985. During the reconnaissance it was apparent that the seeding of Black Locust in this area was very successful. Some trees were approximately 12 feet tall (Photo C-9). In February 1987, 15,000 Black Locust trees were planted on the approximately 15 acres of tailings that form the drainage area for Gap "G" (Photos C-6 and C-7).

The latest activity was in September and October 1987 when some 20,000 feet of wind fencing was installed on the upper portion of the tailings area. During the FIT reconnaissance it was noted that much of this fencing was damaged or blown down due to a recent storm. Reconstruction of the fencing, as well as reinforcement, are planned. It was obvious that the wind fencing was controlling some movement of the sand-like material, but it is ineffective during stronger winds (Photos C-4 and C-5 ) (Ref. 8).

In 1985 the Desloge Tailings Task Force contracted the engineering firm Burns and McDonnell, Inc., to develop a long-term stabilization plan. The investigation and report was funded 25 percent by the

Table 2  
Site History and Stabilization Efforts

Date	Chronology of Pertinent Site Events
1929-1958	Mining occurred and tailings were deposited in slurry form.
1973	St. Joe Minerals Corporation donated 502 acres to St. Francois County. St. Francois County leased the land to the St. Francois County Environmental Corporation which opened the existing landfill.
1977	Collapse of tailings in Gaps A and B; SVAN reports degradation of Big River due to influx of tailings during collapse.
1980	Missouri Department of Conservation determined elevated Pb levels in bottom-feeding fish and issued a press release cautioning local residents not to eat these fish.
1981	St. Joe Minerals began remedial activity in an attempt to stabilize the tailings.
1983	Gaps "G" and "H" were formed by overtopping of the retaining berm.
1984	1,500 feet of wind fencing installed.
1985	Desloge Tailings Task Force was organized Gaps "I" was formed by overtopping Burns & McDonnell long term stabilization plan 20 acres near Gap "I" were seeded, and appear to be growing well.
1986	10,000 Black Locust trees planted near Gap "I".
1987	Monitoring wells installed around landfill. Some 15,000 Black Locust trees planted near Gap "G". 20,000 feet of wind fencing installed.

landfill corporation and 75 percent by St. Joe Minerals. The Burns and McDonnell proposal was highly criticized because it included creating several ponds on the tailings pile to control surface runoff (Ref. 10). Because of the proven instability of the tailings, the plan to create ponds on the pile was not considered a satisfactory solution. The chronology of the significant stabilization efforts is summarized in Table 2.

In April 1987 the Soil Conservation Service proposed some stabilization plans for the site to the Desloge Mine Tailings Task Force. They suggested diverting the surface drainage away from critical erosion areas and planting some test plots to determine what methods might be best for revegetation (Ref. 11). Current plans are to carry out revegetation test plot experiments in an attempt to determine what plants and planting methods are best suited to the mine tailings.

#### 2.4 SITE CONTACTS. BIG RIVER MINE TAILINGS

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Poplar Bluff, Missouri  
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5. Gene Gunn  
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Superfund Contact  
Kansas City, Kansas  
(913) 236-2856

### SECTION 3: WASTE CHARACTERISTICS

It has been determined that the mine tailings located at the Big River Desloge Tailings pile contain significant amounts of lead, cadmium and zinc (Ref. 10). The tailings from the pile are migrating into the river and ambient air via water and wind erosion. Therefore, it is possible that these heavy metals constituents may be contaminating the river and the air. This section will discuss the three heavy metals of concern (lead, cadmium, and zinc) their characteristics, potential hazards, and relevant EPA Maximum Contaminant Levels (MCL).

Lead exists in nature mainly as lead sulfide (galena). Other common forms are lead carbonate (cerussite), lead sulfate (anglesite) and lead chlorophosphates (pyromorphite). Stable complexes result from the interaction of lead with the sulfhydryl, carboxyl, and amine coordination site found in living matter. The toxicity of lead in water is affected by pH, hardness, organic materials, and the presence of other metals. The aqueous solubility of lead ranges from 500 ug/l in soft water to 3 ug/l in hard water (Ref. 13).

Lead is a toxic metal that tends to accumulate in the tissues of humans and other animals. Although seldom seen in the adult population, irreversible damage to the brain is a frequent result of lead intoxication in children. This most commonly results from ingestion of lead-containing paint found in older homes. The major toxic effects of lead include anemia, neurological dysfunction, and renal impairment. The most common symptoms of lead poisoning, which usually develop slowly, are anemia, severe intestinal cramps, paralysis of nerves (especially the arms and legs), loss of appetite, and fatigue. The Maximum Contaminant Level (MCL) established for lead in drinking water is 50 ug/l (Ref. 14). The National Ambient Air Quality Primary Standard for lead in the air in a calendar quarter is  $1.5 \text{ ug/m}^3$  (Ref. 15).

Cadmium occurs mainly as a sulfide salt, frequently in association with zinc and lead ores (Ref. 13). Accumulation of cadmium in soils in the vicinity of mines and smelters may result in high local concentrations in nearby waters. Cadmium is deposited and accumulated in various body tissues. Cadmium may function in or may be an etiological factor for various human pathological processes including testicular tumors, renal dysfunctions, hypertension, arteriosclerosis, growth inhibition, chronic diseases of old age, and cancer (Ref. 13). The MCL established for cadmium in drinking water is 10 ug/l (Ref. 14).

Zinc is usually found naturally as a sulfide and it is often associated with other metals, especially lead, copper, cadmium and iron. It is used in galvanizing processes and in preparation of alloys. Zinc is essential and beneficial in human metabolism. Community water supplies tested have contained 11 to 27 mg/l without harmful effects. The toxicity of zinc compounds to aquatic animals is modified by environmental factors. An increase in temperature and reduction in dissolved oxygen increases the toxicity of zinc for fish. Toxic concentrations of zinc compounds cause adverse changes in the morphology and physiology of fish (Ref. 13). The final secondary MCL established for zinc is 5,000 ug/l (Ref. 14). No primary MCL for zinc has been established.

In a study prepared by the University of Missouri Rolla, the Desloge tailings pile was sampled extensively (77 samples were taken) for its lead, cadmium, and zinc content. Values for lead range from 826 to 6,200 ug/g with a mean of 2077 ug/g; cadmium ranged from 6.8 to 78.6 with a mean of 26 ug/g. Zinc ranged from 233 to 3,990 ug/g with a mean of 1,226 ug/g. See Appendix D for complete sample results (Ref. 12).



## SECTION 4: PAST INVESTIGATIONS

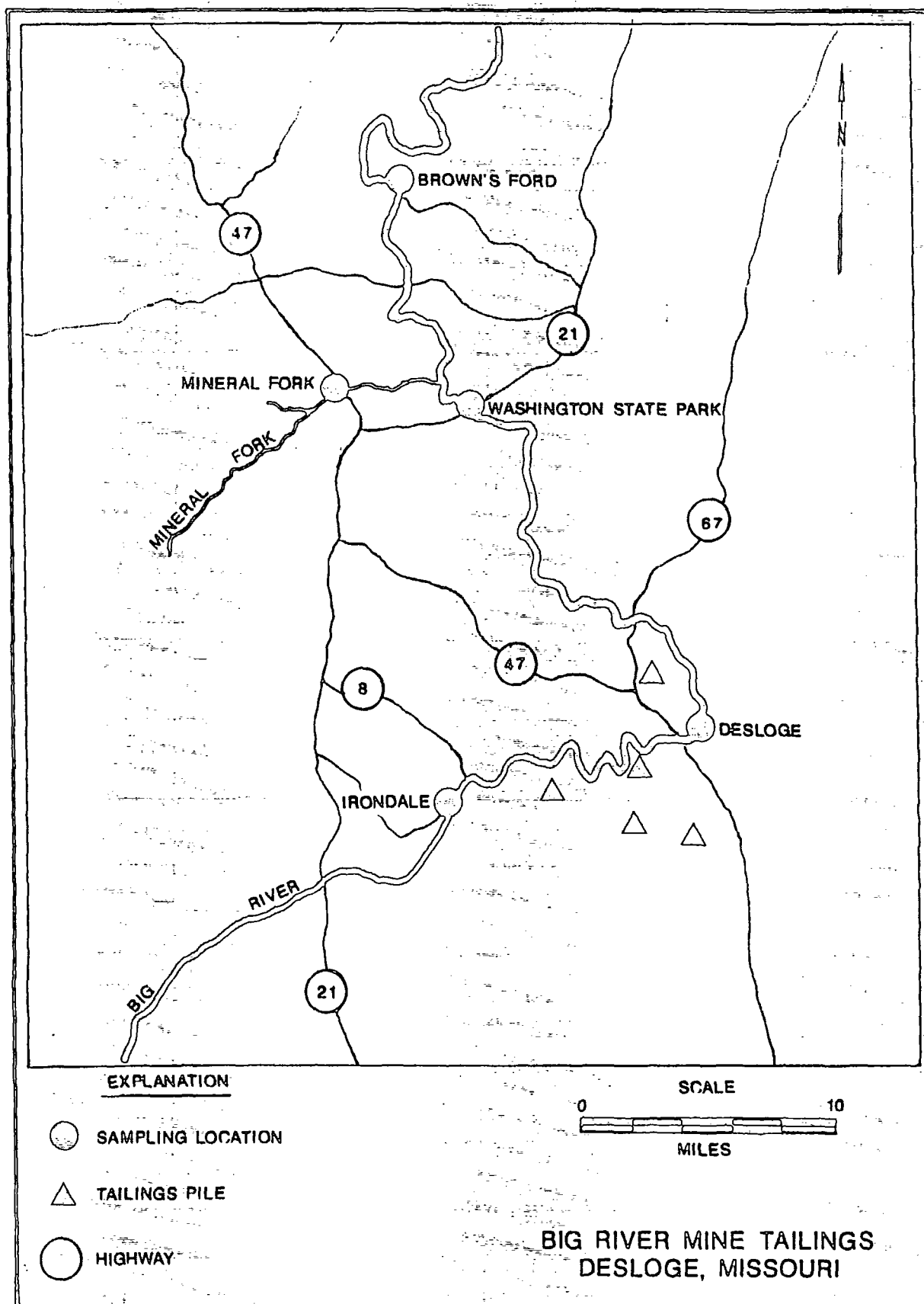
Numerous investigations regarding the effects of mine tailings on the Big River have been completed since the massive erosional event in 1977. This section will address the significant results of this research.

### 4.1 METALS IN BIG RIVER WATER AND SEDIMENT

In a report submitted by the National Fisheries Research Laboratory the metals content in river water and sediment was measured at different locations along the Big River (Figure 5). The Irondale and Mineral Fork sample locations were considered control areas while Desloge, Washington State Park, and Brown's Ford sites are 5 miles, 37 miles and 60 miles, respectively downstream from the Desloge Mine Tailings pile.

Water sampling was done during low, medium, and high flow. Total metals and dissolved metals were measured for lead (Pb), cadmium (Cd) and zinc (Zn). The highest total Pb (0.68 mg/l) was found at Washington State Park and the highest dissolved Pb (0.026) occurred at Brown's Ford (Table 3). The dissolved Pb concentrations were all below the 0.05 mg/l MCL for Pb. Cd and Zn concentrations were all within established MCLs for these compounds.

Sediment samples were collected from corresponding locations on the Big River. Total sediment Pb concentrations were highest at Desloge (2215.0 ug/g) and tended to decrease with distance downstream. This value is similar to the Pb content found in the tailings at the Desloge pile (Appendix D). Total Pb concentration was lowest (49.6 ug/g) at Irondale. Concentration at Mineral Fork were substantially higher than at Irondale, though were lower here than at other locations. This is probably attributable to the past Pb mining or on-going barite mining activities in the Mineral Fork watershed. These sampling results show how the mine tailings had affected the benthic zone of the Big River at the Desloge mining pile and for several miles downstream (Table 3) (Ref. 16).



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PREPARED BY: R. OVERFELT

ECOLOGY & ENVIRONMENT APRIL 1988  
SOURCE: REFERENCE 16

FIGURE 5: SAMPLE LOCATIONS ON BIG RIVER

Table 3  
Metals Concentrations in Water Samples Collected  
in the Big River  
Big River Mine Tailings, Desloge, Missouri

Location Stage	Flow (CFS)	Pb D T	Cd D T	Zn D T
Mineral Fork				
Low	29.6	0.005 0.009	0.001	0.001 <0.01
Med.	160.0	0.006 0.005	0.001	0.001 <0.01
High	505.0	0.005 0.009	0.001	0.001 <0.01
Brown's Ford				
Low	95.6	0.005 0.043	0.001	0.001 0.02
Med.	650.0	0.007 0.084	0.001	0.001 0.01
High	11900.0	0.026 0.440	0.001	0.001 0.05
Washington State Park				
Low	70.2	0.009 0.091	<0.001	<0.001 0.01
Med.	490.0	<0.005 0.140	<0.001	<0.001 0.01
High	11395.0	0.021 0.680	<0.001	<0.004 -----
Desloge				
Low	45.3	0.020 0.041	0.002	0.004 0.31
Med.	298.0	0.010 0.085	0.001	0.001 0.06
High	932.0	0.012 0.110	0.002	0.004 0.10
Irondale				
Low	7.1	0.005 0.005	0.001	0.001 <0.01
Med.	160.0	0.005 0.005	0.001	0.001 <0.01
High	300.0	0.005 0.005	0.001	0.001 <0.01

Reporting unit is mg/l.

NOTE: CFS = Cubic feet per second.  
D = Dissolved Metals; T = Total Metals.

Source: National Fisheries Research Laboratory Report (Ref. 16).

Table 4  
Metals Concentrations in Sediment Samples  
Collected in the Big River  
Big River Mine Tailings, Desloge Missouri

Location	Pb	Cd	Zn
Irondale	49.6	1.62	64.9
Desloge	2,215.0	29.96	1658.4
Washington State Park	1,843.4	10.79	704.3
Brown's Ford	1,438.3	6.55	484.5
Mineral Fork	291.5	2.52	369.7

NOTE: Adjusted total sediment metal concentrations (ug/g dry weight).

Source: National Fisheries Research Laboratory Report (Ref. 16).

#### 4.2 METALS IN AQUATIC BIOTA

Several past studies have focused on the elevated metal levels in the aquatic biota present in the Big River.

In the report prepared by the National Fisheries Laboratory, crayfish, fresh water mollusks, and fish also were sampled. The sample locations were the same as for surface water and sediments (Figure 5). In crayfish samples, Pb and Cd levels were elevated at Desloge, Washington State Park, and Brown's Ford. The highest Pb concentration was 140 ug/g at Desloge. Pb concentrations of crayfish were 1.4 ug/g at Irondale and 2.7 ug/g at Mineral Ford. Since crayfish feed on aquatic macrophytes and detritus they can accumulate sediment-bound toxins.

Pocketbook mussels were collected at all the locations except Desloge, where none could be found. Results showed the highest mean Pb concentrations at Brown's Ford ranging from 310 to 490 ug/g in soft tissue and 18 to 19 ug/g in the shell. Pb levels at Washington State Park were from 200 to 310 ug/g in soft tissue and 8 to 22 ug/g in the shell. The control sample at Irondale had mean Pb levels of 2.16 ug/g in soft tissue and 0.76 ug/g in the shell.

The results of fish samples collected on the Big River varied with fish types. Bottom-feeders, such as catfish and the Redhorse sucker, tended to have higher concentrations of metals than fish such as the smallmouth bass that do not feed on bottom sediment. The Pb content in the Redhorse sucker was greater than the 0.3 ug/g dietary limit recommended by the World Health Organization (WHO) at Desloge (0.57 ug/g), Washington State Park (0.43 ug/g), and Brown's Ford (0.63 ug/g). The Pb concentrations at Irondale and Mineral Fork were well below the WHO limit (Table 5) (Ref. 16).

Research conducted on fish over a five-year period by the University of Missouri Rolla confirms the above results. This research shows that over a five-year period, the Pb concentrations in suckers from the Big River near the lead tailings piles have consistently exceeded the WHO limit (Ref. 17).

These research results demonstrate that mine tailings have raised lead levels in the benthic zone of the Big River and in the bottom feeders that live in this zone of the river. This study also determined that the tailings have had little effect on the heavy metals content in the river water.

#### 4.3 MINE TAILINGS FOR USE AS AGRICULTURAL LIME

Research done by the University of Missouri Rolla on the possible use of mine tailings as agricultural lime determined that this practice may be acceptable. It also states that caution should be taken because some older tailings piles have much higher concentrations of Pb than more recently developed piles. It must also be noted that plant uptake studies have indicated that both lettuce and radishes tend to accumulate some Pb and Cd when lead/zinc tailings were mixed with soil as agricultural lime (Ref. 12).

#### 4.4 LEAD IN DUST FROM TAILINGS PILE

The Missouri Department of Natural Resources (MDNR) collected air quality data near Flat River, Missouri, approximately 2 miles southeast of the Desloge mine tailings pile. MDNR used one hi-vol monitor located approximately 2,000 feet north of the St. Joe Park Tailings Pile near

Flat River. Data was collected for the three-year period 1981, 1982, and 1983. Monitor filters taken during the initial sampling period of January through August 1981 were analyzed for Pb. No additional filters in the three-year period were analyzed for Pb. The total suspended particulate (TSP) annual geometric mean in 1981 was 50.55; 1982 was 35.47; and 1983 was 47.43  $\text{ug}/\text{m}^3$  (Ref. 18). The National Ambient Air Quality Standard (NAAQS) for the annual geometric mean of TSP is 75  $\text{ug}/\text{m}^3$  (Ref. 15). The results of the Pb analyses for the first three quarters of 1981 were January-March 0.14  $\text{ug}/\text{m}^3$ , April-June 1.09  $\text{ug}/\text{m}^3$ , and July-August 0.17  $\text{ug}/\text{m}^3$  (Ref. 18). The NAAQS primary standard for Pb in a calendar quarter is 1.5  $\text{ug}/\text{m}^3$  (Ref. 15). These results are all within the standards for air quality and are adequate for southerly winds. Because the prevailing winds in this part of the country vary from season to season or month to month additional hi-vol monitoring devices situated around the tailings pile would have been more effective than one unit (Ref. 19). Also, a background or control hi-vol monitor was not used, so no control data is available for comparison.

Table 5  
Metals Concentrations in Edible Portions  
of Fish in the Big River  
Big River Mine Tailings-Desloge, Missouri

Location Species	Pb	Cd	Zn
<b>Mineral Fork</b>			
Smallmouth bass	0.19	0.01	13.97
Yellow bullhead	0.13	0.02	5.67
Redhorse sucker	0.08	0.01	13.42
<b>Brown's Ford</b>			
Smallmouth bass	0.21	0.01	4.50
Flathead catfish	0.29	0.02	12.24
Redhorse sucker	0.63	0.01	11.67
<b>Washington State Park</b>			
Smallmouth bass	0.27	0.01	9.49
Flathead catfish (4)	12.00	0.34	23.00
Redhorse sucker	0.43	0.01	9.38
Mixed suckers	0.38	-----	-----
<b>Desloge</b>			
Smallmouth bass	0.05	0.01	11.73
Channel catfish	0.13	0.03	5.12
Redhorse sucker	0.57	0.03	16.15
Mixed sucker (2)	0.79	-----	-----
<b>Irondale</b>			
Smallmouth bass	0.01	<0.01	13.28
Flathead catfish	0.06	0.06	6.75
Redhorse sucker	0.02	0.01	9.32
Mixed sucker	0.07	-----	-----

NOTE: Means of two samples (individual fish) unless otherwise indicated.  
Reporting unit is ug/l wet weight.

Source: National Fisheries Research Laboratory Report (Ref. 16).

## SECTION 5: PHYSICAL SETTING

### 5.1 CLIMATOLOGY AND DEMOGRAPHY

St. Francois County is hot in summer, especially at low elevations, and moderately cool in winter, especially on mountains and high hills. Rainfall is fairly heavy and well distributed throughout the year. Snow falls nearly every winter, but snow cover lasts only a few days at a time.

In winter the average temperature is 35 degrees F, and the average daily minimum temperature is 24 degrees F. In summer the average temperature is 75 degrees F, and the daily average maximum is 88 degrees F.

Of the total annual precipitation, 23 inches, or 60 percent, usually falls in April through September. The heaviest 1-day rainfall during the period of record was 4.95 inches at Farmington on June 30, 1957. Thunderstorms occur on about 50 days each year occurring primarily in summer. Average seasonal snowfall is 12 inches.

The average relative humidity is about 60 percent. Humidity is higher at night and the average at dawn is 80 percent. The prevailing wind is from the south. Average windspeed is highest, 12 miles per hour, in March. The climate is classified as humid continental (Ref. 20).

The population of St. Francois County recorded in 1982 was 42,600. Farmington, Missouri is the county seat and has a population of 8,270. Desloge, located 2,500 feet southeast and 300 feet south of the site, has a population of 3,481 (Ref. 26).

### 5.2 TOPOGRAPHY AND DRAINAGE

The Big River Mine Tailings site lies on the eastern side of the Ozark Highland in St. Francois County, Missouri. The major physical features in the area are the St. Francois Mountains to the south, the



Farmington Plain to the east, and the dissected topography of the Salem Plateau located to the north (Ref. 20). The site is between these major features on the floodplain of the Big River. The basin topography of the site is a rounded hill which slopes on the east, north, and west sides toward the Big River. A contour map of the site is included as Appendix E.

The on-site drainage pattern is discussed extensively in Section 2.3. The site drains primarily into the Big River along the entire perimeter of the horse-shoe bend where the site abuts the river and forms the site boundary.

### 5.3 SOILS

Most of the site is characterized by Psammments soils. This unit consists of deep, nearly level to gently rolling, excessively drained, newly formed soil in tailings ponds. These soils are formed in crushed dolomitic material from lead mining. Permeability is rapid and surface runoff is slow to medium although most precipitation is absorbed into the surface. The available water capacity is low. The natural fertility is very unbalanced, and careful fertilization is required to make the soil suitable for any plant growth. The organic matter is also very low. Some areas have been seeded to grasses and legumes but results are poor. These soils are generally unsuitable for growing grasses, shrubs, and trees unless intensively managed.

The areas where natural vegetation occurs on site consist mainly of Caneyville silt loam except for a small area on the southwest portion of the site where Gasconade, flaggy, silty, clay loam occurs.

Caneyville silt loam has 2 to 5 percent slopes and is moderately deep, well drained. This soil occurs on convex ridgetops. The surface layer is a dark-brown silt loam about 5 inches thick with a subsoil of silty clay loam and silty clay about 30 inches thick. Permeability is moderately slow, and surface runoff is slow to medium. Available water capacity is low.

Gasconade flaggy, silty, clay loam has 9 to 35 percent slopes, is excessively drained, and occurs on uneven side slopes. The surface layer is a very dark-brown flaggy, silty, clay loam about 8 inches thick. The subsoil is dark-brown very flaggy, silty, clay about 5 inches thick. Permeability is moderately slow, and surface runoff is rapid. Available water capacity is very low.

All of the soils on site are underlain by hard-bedded dolomite (Ref. 20).

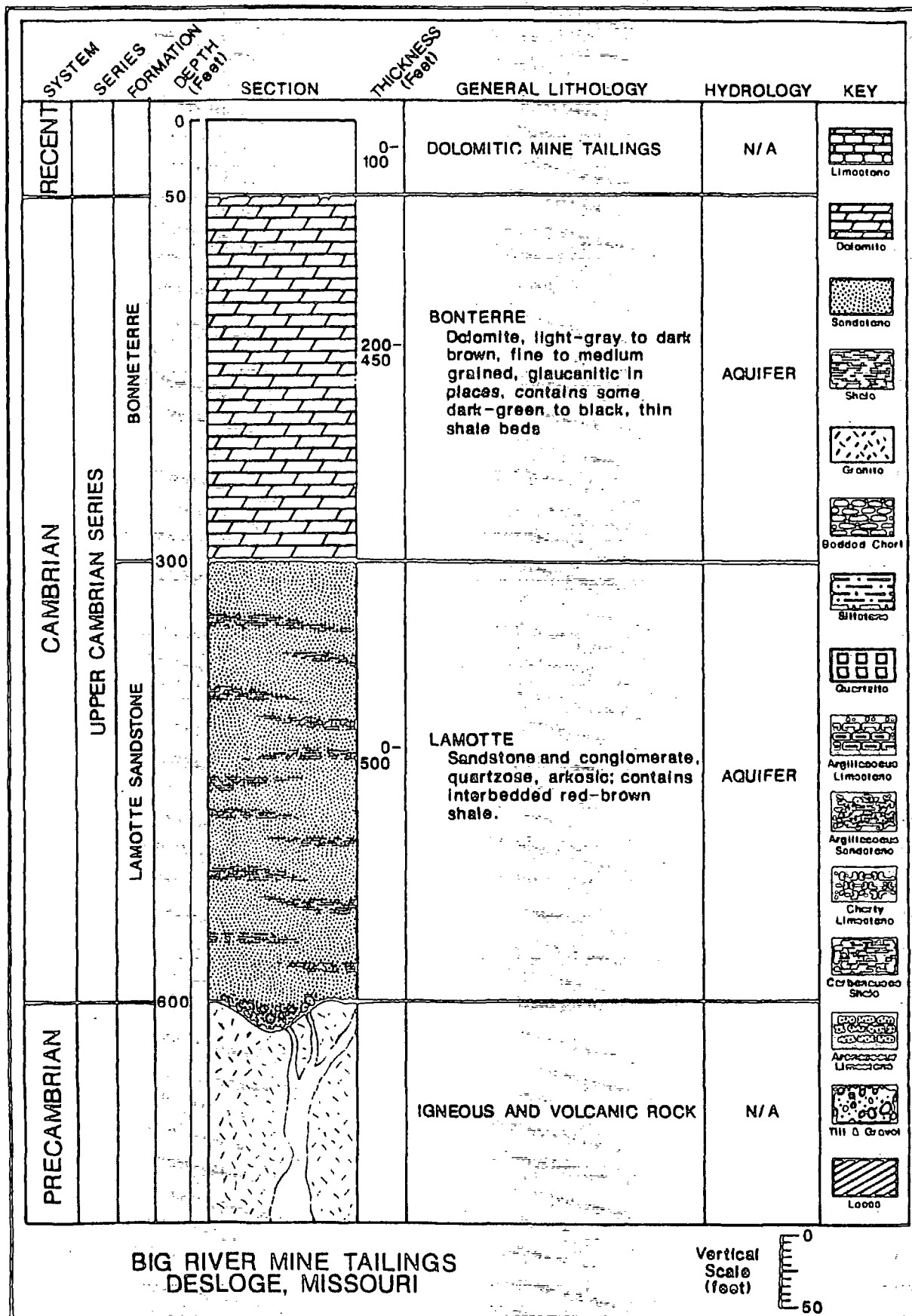
#### 5.4 STRATIGRAPHY

The Big River Mine Tailings site is underlain by Precambrian felsites and granites, which are overlain by rock units of the Upper Cambrian series (Ref. 21 and 22). Figure 6 depicts the general stratigraphy of the site vicinity.

The Upper Cambrian Series rock units consist of in ascending order; the Lamotte Formation; the Bonneterre Formation; and the Elvins Group, which contains the Davis and Derby-Doerun formations. The Elvins Group, and the Potasi and Eminence formations will not be considered in this report because they are topographically higher than the Big River Mine Tailings site (Ref. 21 and 22).

The Lamotte Formation is predominantly a quartzose sandstone that grades laterally in many places into arkose and conglomerate (Ref. 22). The formation is approximately 300 feet thick in the study area (Ref. 21). The Lamotte aquifer is a regional drinking water source (Ref. 23).

The Bonneterre Formation is typically a light-gray, medium to fine-grained, medium-bedded dolomite, although it consists of relatively pure limestone in some areas (Ref. 22). The formation is approximately 350 feet thick in the study area. This formation is the principal source for lead mining in the area that occurred in the late 19th and early to mid 20th centuries. The Bonneterre aquifer is also a regional drinking water source (Ref. 23).



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PREPARED BY: C. WILLIAMS

ECOLOGY & ENVIRONMENT FIT APRIL 1988  
SOURCE: REFERENCE 22

FIGURE 8: GENERALIZED STRATIGRAPHIC COLUMN

## 5.5 HYDROGEOLOGY

The area ground water aquifers that are topographically lower than the site are the Bonneterre and Lamotte Formations. The Flat River Water District serves the towns of Desloge, Elvin, Flat River, Leadington, River Mines, and Ester, Missouri. The approximate population served is 12,000 (Ref. 24). The Big River Mine Tailings site is adjacent to the town of Desloge and is within 2 miles of Flat River. The Flat River Water District's water supply comes from the Bonneterre Formation, via a sealed, abandoned mine shaft located approximately 2 miles south of the site in River Mines, Missouri; and from the Lamotte Formation, via a well located approximately 3,000 feet east in Desloge, Missouri, that is pumped from 410 feet (Ref. 24).

The typical ground water flow around the site is toward the river. Several natural springs around the site area flow into the Big River (Ref. 9). When the river is at flood stage, ground water may not flow toward the river, though this situation is unusual.

## SECTION 6: SUMMARY AND CONCLUSIONS

In the spring of 1977 a catastrophic erosional event occurred in which a massive portion of the 600-acre Desloge Mine Tailings pile flowed into the Big River. As a result of this event, mine tailings laden with heavy metals were distributed several miles downstream. The tailings covered the benthic zone of the Big River and altered its physical and chemical composition. Because several other tailings piles exist in the area, it is difficult to attribute all of the heavy metal contamination in the Big River to the Desloge tailings pile. Certainly, the Desloge pile has been a major source of the tailings entering the Big River and has had a detrimental effect on the water quality in the river. It has been established through numerous research projects that lead concentrations are elevated in certain benthic-feeding biota at the Desloge tailings pile and for several miles downstream.

Some data has been collected to determine whether lead-bearing total suspended particulates are a concern at this site. Additional monitoring would be required to accurately characterize this element. The day of the FIT reconnaissance, strong winds had created a suspended particulate plume that originated at the site and was carried over the town of Desloge (Photos C-1, C-2, C-4).

The on-site county landfill has raised many concerns. The landfill operators apply a soil cap when filling is completed, which reduces wind erosion considerably. However, the potential for the release of lead to ground water and surface water (Big River) via acidic leachate from the landfill is high.

Remedial action by St. Joe Minerals Corp. has reduced water and wind erosion in certain areas. Yet the majority of the site remains extremely susceptible to wind erosion and water erosion is a severe, chronic problem in other areas.

Stabilization efforts have been undertaken by several agencies. Since 1985 St. Joe Minerals, the county landfill, and the Desloge Tailings Task Force all have made a concerted effort to provide adequate supervision and maintenance of the Desloge tailings pile, and have investigated possibilities for long-term stabilization of the site.

The Big River Mine Tailings site near Desloge, Missouri, is a documented source of chemical contamination. Additionally, erosional events have altered the benthic zone of the Big River. The site area is huge, covering approximately 600 acres. Though stabilization efforts have achieved some success, much more work is needed to minimize the erosion which now adversely influences the Big River and the local ambient air.

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**APPENDIX A**

**EPA Form 2070-12**

## POTENTIAL HAZARDOUS WASTE SITE

## PRELIMINARY ASSESSMENT

## PART 1 - SITE INFORMATION AND ASSESSMENT

## I. IDENTIFICATION

01 STATE MO 02 SITE NUMBER D981126899

## SITE NAME AND LOCATION

SITE NAME (Legal, common, or descriptive name of site)  
Liver Mine Tailings02 STREET, ROUTE NO., OR SPECIFIC LOCATION IDENTIFIER  
Approximately 1 mile northwest of Doslogo, Missouri

04 STATE MO 05 ZIP CODE 63601 06 COUNTY St. Francois 07 COUNTY CODE 08 CONG DIST

COORDINATES LATITUDE LONGITUDE  
53° 11' 4N 90° 33' 00" W

## ACTIONS TO SITE (Starting from nearest public road)

Hwy 67 south to Doslogo. From Doslogo the site is approximately 1 mile northwest and is bordered by a district of the Big River on its west, north, and east sides.

## RESPONSIBLE PARTIES

OWNER (If known)  
St. Francois County

02 STREET (Business, mailing, residential)

04 STATE MO 05 ZIP CODE 63601 06 TELEPHONE NUMBER (314) 431-6505

RATOR (If known and different from owner)  
St. Francois County Environmental Corp.

08 STREET (Business, mailing, residential)

10 STATE MO 11 ZIP CODE 63601 12 TELEPHONE NUMBER (314) 431-4768

## TYPE OF OWNERSHIP (Check one)

☐ A. PRIVATE ☐ B. FEDERAL: (Agency name) ☐ C. STATE ☒ D. COUNTY ☐ E. MUNICIPAL  
☐ F. OTHER: (Specify) ☐ G. UNKNOWN

## OWNER/OPERATOR NOTIFICATION ON FILE (Check all that apply)

CRA 3001 DATE RECEIVED: MO/DAY/YR ☐ B. UNCONTROLLED WASTE SITE (CERCLA 103 c) DATE RECEIVED: MO/DAY/YR ☐ C. NONE

## CHARACTERIZATION OF POTENTIAL HAZARD

## SITE INSPECTION BY (Check all that apply)

☒ YES DATE 1/25/88 MO/DAY/YR ☒ A. EPA ☒ B. EPA CONTRACTOR ☐ C. STATE ☐ D. OTHER CONTRACTOR  
☐ NO ☐ E. LOCAL HEALTH OFFICIAL ☐ F. OTHER: (Specify)  
CONTRACTOR NAME(S): E & E/FIT

## E STATUS (CHECK ONE)

☐ A. ACTIVE ☒ B. INACTIVE ☐ C. UNKNOWN

## 03 YEARS OF OPERATION

1929 1958 UNKNOWN  
BEGINNING YEAR ENDING YEAR

## DESCRIPTION OF SUBSTANCES POSSIBLY PRESENT, KNOWN, OR ALLEGED

tailings which contain a mean value of 2,077 ppm lead (Pb), 26 ppm Cadmium (Cd) and 1,226 ppm zinc (Zn).  
Tailings cover approximately 600 acres at a depth of 0-100 feet within a "horseshoe" of the Big River.

## DESCRIPTION OF POTENTIAL HAZARD TO ENVIRONMENT AND/OR POPULATION

Flow of tailings into the Big River.  
Potential health hazard from the dispersion of lead laden dust in the air.  
Potential for landfill organic chelating agents to solubilize and mobilize Pb, Zn, and Cd.

## PRIORITY ASSESSMENT

PRIORITY FOR INSPECTION (Check one. If high or medium is checked, complete Part 2 - Waste Information and Part 3 - Description of Hazardous Conditions and Incidents)

☐ A. HIGH ☐ B. MEDIUM ☐ C. Low ☐ D. NONE

Inspection required (Inspection required) (Inspect on time available basis) (No further action needed. Complete current disposition form)

## INFORMATION AVAILABLE FROM

CONTACT  
Gunn 02 OF (Agency/Organization) EPA Superfund Branch 03 TELEPHONE NUMBER (913) 236-2856  
PERSON RESPONSIBLE FOR ASSESSMENT  
Gunn 05 AGENCY E & E 06 ORGANIZATION FIT 07 TELEPHONE NUMBER 913-432-9961 08 DATE 4/27/88 MO/DAY/YR

## PART 2 - WASTE INFORMATION

02 SITE NUMBER  
D981126899

## M. NOT APPLICABLE

DRY	SUBSTANCE NAME	01. GROSS AMOUNT	02. UNIT OF MEASURE	03. COMMENTS
	SLUDGE			
	OILY WASTE			
	SOLVENTS			
	PESTICIDES			
	OTHER ORGANIC CHEMICALS			
	INORGANIC CHEMICALS			
	ACIDS			
	BASES			
	HEAVY METALS	Unknown		Lead, Zinc,

[illegible]

EGORY	01 FEEDSTOCK NAME	02 CAS NUMBER	CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER
OS			FDS		
OS			FDS		
OS			FDS		
OS			FDS		

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## POTENTIAL HAZARDOUS WASTE SITE

## PRELIMINARY ASSESSMENT

## I. IDENTIFICATION

01 STATE MO 02 SITE NUMBER D981126899

## PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

## HAZARDOUS CONDITIONS AND INCIDENTS

- A. GROUNDWATER CONTAMINATION 02 ☐ OBSERVED (DATE: ☐) ☒ POTENTIAL ☐ ALLEGED  
CONTAMINATION POTENTIALLY AFFECTED: 04 NARRATIVE DESCRIPTION  
There is potential for ground water contamination from surface water because faults exist in the site area. The on-landfill may release organic chelating agents which could release heavy metals into the ground water.
- B. SURFACE WATER CONTAMINATION 02 ☐ OBSERVED (DATE: ☐) ☐ POTENTIAL ☐ ALLEGED  
CONTAMINATION POTENTIALLY AFFECTED: 04 NARRATIVE DESCRIPTION  
The site and several miles downstream the bottom of the Big River is lined with mine tailings. This has raised Pb and Zn levels slightly in the water. There is potential for more mine tailings to erode into the river.
- C. CONTAMINATION OF AIR 02 ☐ OBSERVED (DATE: ☐) ☒ POTENTIAL ☐ ALLEGED  
CONTAMINATION POTENTIALLY AFFECTED: 04 NARRATIVE DESCRIPTION  
Dust laden dust blows off the top of the mine tailings pile.
- D. FIRE/EXPLOSIVE CONDITIONS 02 ☐ OBSERVED (DATE: ☐) ☐ POTENTIAL ☐ ALLEGED  
CONTAMINATION POTENTIALLY AFFECTED: 04 NARRATIVE DESCRIPTION  
None known or reported to date
- E. DIRECT CONTACT 02 ☐ OBSERVED (DATE: ☐) ☐ POTENTIAL ☐ ALLEGED  
CONTAMINATION POTENTIALLY AFFECTED: 04 NARRATIVE DESCRIPTION  
People are currently and have in the past driven all terrain vehicles (ATVs) on the mine tailings pile for recreation. Also landfill workers are exposed to the tailings daily.
- F. CONTAMINATION OF SOIL 02 ☐ OBSERVED (DATE: ☐) ☐ POTENTIAL ☐ ALLEGED  
AREA POTENTIALLY AFFECTED: 600 (Acres) 04 NARRATIVE DESCRIPTION  
Mine tailings cover approximately 600 acres.
- G. DRINKING WATER CONTAMINATION 02 ☐ OBSERVED (DATE: ☐) ☐ POTENTIAL ☐ ALLEGED  
CONTAMINATION POTENTIALLY AFFECTED: 04 NARRATIVE DESCRIPTION  
None known or reported to date
- H. WORKER EXPOSURE/INJURY 02 ☐ OBSERVED (DATE: ☐) ☐ POTENTIAL ☐ ALLEGED  
WORKERS POTENTIALLY AFFECTED: 04 NARRATIVE DESCRIPTION  
None known or reported to date
- I. POPULATION EXPOSURE/INJURY 02 ☐ OBSERVED (DATE: ☐) ☐ POTENTIAL ☐ ALLEGED  
CONTAMINATION POTENTIALLY AFFECTED: 04 NARRATIVE DESCRIPTION  
None known or reported to date

POTENTIAL HAZARDOUS WASTE SITE

I. IDENTIFICATION

PA

PRELIMINARY ASSESSMENT

01 STATE MO 02 SITE NUMBER D981126899

PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

HAZARDOUS CONDITIONS AND INCIDENTS (CONTINUED)

J. DAMAGE TO FLORA 02 ☒ OBSERVED (DATE: 1/25/88 ) POTENTIAL ALLEGED

NARRATIVE DESCRIPTION

Partial recovery of vegetation has occurred. The 600 acres of mine tailings are virtually bare.

K. DAMAGE TO FAUNA 02 ☐ OBSERVED (DATE: ) POTENTIAL ALLEGED

NARRATIVE DESCRIPTION (Include name(s) of species)

Lead levels of Pb, Cd, and Zn were found in a study that examined algae.

L. CONTAMINATION OF FOOD CHAIN 02 ☐ OBSERVED (DATE: ) POTENTIAL ALLEGED

NARRATIVE DESCRIPTION

Bottom-feeding fish in the Big River are known to have elevated levels of Pb in their edible tissue. Fish are not for human consumption through sport fishing from the Big River.

M. UNSTABLE CONTAINMENT OF WASTES 02 ☒ OBSERVED (DATE: 1977 ) POTENTIAL ALLEGED

Leakage/runoff/standing liquids/leaking drums)

CONTAMINATION POTENTIALLY AFFECTED: 04 NARRATIVE DESCRIPTION

Flow of mine tailings into the Big River.

N. DAMAGE TO OFFSITE PROPERTY 02 ☒ OBSERVED (DATE: 1977 ) POTENTIAL ALLEGED

NARRATIVE DESCRIPTION

Big River bottom is lined with mine tailings for several miles downstream from the site and the biota in the river contain elevated Pb, Cd, and Zn levels.

O. CONTAMINATION OF SEWERS, STORM DRAINS, WWTPs 02 ☐ OBSERVED (DATE: ) POTENTIAL ALLEGED

NARRATIVE DESCRIPTION

None known or reported to date

P. ILLEGAL/UNAUTHORIZED DUMPING 02 ☐ OBSERVED (DATE: ) POTENTIAL ALLEGED

NARRATIVE DESCRIPTION

None known or reported to date

DESCRIPTION OF ANY OTHER KNOWN, POTENTIAL, OR ALLEGED HAZARDS

TOTAL POPULATION POTENTIALLY AFFECTED: 27,739 (3-mile radius)

COMMENTS

SOURCES OF INFORMATION (Cite specific references. e.g., state files, sample analysis, reports)

Study of Mine Tailings Discharge to Big River, Dr. John Novak 1980, EPA files. Preliminary investigation on the dynamics of metals from past and present mining activities in the Big and Black Rivers, Southeastern Missouri, Preliminary, EPA files.

APPENDIX B

Well Logs for Monitoring Wells  
Surrounding On-Site Landfill

APPENDIX B

Well Logs for Monitoring Wells  
Surrounding On-Site Landfill

MUDWALKER & ASSOCIATES, INC.  
Engineers - Surveyors  
P. O. Box 676  
FARMINGTON, MO 63640

# LETTER OF TRANSMITTAL

(314) 756-6775

Ecology & Environment, Inc.

6405 Metcalf

Building 3 - Suite 404

Overland Park, KS 66202

DATE	11/12/87	JOB NO.
ATTENTION	Mr. Bob Overfelt	
RE:	Design Tailings Pile	

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via \_\_\_\_\_ the following items:

- |   |  |                                |                                  |   |
|---|--|--------------------------------|----------------------------------|---|
| <input type="checkbox"/> Shop drawings  | <input checked="" type="checkbox"/> Prints | <input type="checkbox"/> Plans | <input type="checkbox"/> Samples | <input type="checkbox"/> Specifications |
| <input type="checkbox"/> Copy of letter | <input type="checkbox"/> Change order      | <input type="checkbox"/> _____ |                                  |   |

COPIES	DATE	NO.	DESCRIPTION
1			Plan of Monitoring Well locations
1			Monitoring Well Detail

THESE ARE TRANSMITTED as checked below:

- |  |   |   |
|--|---|---|
| <input type="checkbox"/> For approval  | <input type="checkbox"/> Approved as submitted    | <input type="checkbox"/> Resubmit _____ copies for approval   |
| <input checked="" type="checkbox"/> For your use   | <input type="checkbox"/> Approved as noted        | <input type="checkbox"/> Submit _____ copies for distribution |
| <input checked="" type="checkbox"/> As requested   | <input type="checkbox"/> Returned for corrections | <input type="checkbox"/> Return _____ corrected prints        |
| <input type="checkbox"/> For review and comment  | <input type="checkbox"/> _____                    |   |
| <input type="checkbox"/> FOR BIDS DUE _____ 19____ <input type="checkbox"/> PRINTS RETURNED AFTER LOAN TO US |   |   |

REMARKS \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

COPY TO \_\_\_\_\_

SIGNED: 



DATE INSTALL : 1/16/87

DATE DEVELOPED: N/A - dry

782.3  
ELEV

2.75  
DEPTH

TOP OF  
RISER

PROTECTIVE COVER: 4" x 4" Steel

LOCATION: N12461 E8637

GROUND ELEVATION: 779.6 DATUM MSL

DETERMINED BY: Survey

WELL WATER LEVELS

DATE	DEPTH	REMARKS
1/21	39.1	Dry
1/21	37.1	25 Gallons added
1/21	38.6	6 Minutes later
3/11	39.1	Dry

depth measured from top of riser

RISER TYPE: flush coupled PVC

DIAMETER: 2 IN

LENGTH: 24 FT

BACKFILL: bentonite/cement grout

SEAL: bentonite pellets

SAND: medium sand (WB40)

SCREEN DIA: 2 IN LENGTH: 15 FT  
TYPE: PVC

SLOT SIZE: 0.01 IN

BOREHOLE DIAMETER: 9 IN

DRILL METHOD: 4.25" HSA

760.2  
ELEV

19.4  
DEPTH

TOP OF  
SEAL

Below ground surface

759.2  
ELEV

20.4  
DEPTH

TOP OF  
SAND

758.2  
ELEV

21.4  
DEPTH

TOP OF  
SCREEN

743.2  
ELEV

36.4  
DEPTH

BOTTOM  
OF SCREEN

742.1  
ELEV

37.5  
DEPTH

BOTTOM  
OF HOLE

REMARKS:

MONITORING WELL UG-1

GEOTECHNOLOGY  
St. Louis, Missouri

DATE INSTALL : 1/16/87

DATE DEVELOPED: 1/21/87

786.0  
ELEV2.0  
DEPTHTOP OF  
RISER

PROTECTIVE COVER: 4" x 4" Steel

LOCATION: N11851 E9002

GROUND ELEVATION: 784.0 DATUM: MSL

DETERMINED BY: Survey

## WELL WATER LEVELS

DATE	DEPTH	REMARKS
1/21	46.8	
1/21	37.0	Added 36 gallons
1/21	41.4	After 5 minutes
1/21	44.3	After 20 minutes
3/11	46.3	

depth measured from top of riser

RISER TYPE: flush coupled PVC

DIAMETER: 2 IN

LENGTH: 30 FT

BACKFILL: bentonite/cement grout

SEAL: bentonite pellets

758.0  
ELEV26.0  
DEPTHTOP OF  
SEAL

Below ground surface

757.0  
ELEV27.0  
DEPTHTOP OF  
SAND756.0  
ELEV28.0  
DEPTHTOP OF  
SCREEN

SAND: medium sand (WB40)

SCREEN DIA: 2 IN LENGTH: 20 FT  
TYPE: PVC

SLOT SIZE: 0.01 IN

736.0  
ELEV48.0  
DEPTHBOTTOM  
OF SCREEN

BOREHOLE DIAMETER: 9 IN

735.5  
ELEV48.5  
DEPTHBOTTOM  
OF HOLE

DRILL METHOD: 4.25" HSA

REMARKS:

MONITORING WELL DG-1

GEOTECHNOLOGY  
St Louis, Missouri

DATE INSTAL 1/13/87

DATE DEVELOPED: 1/20/87

796.2  
ELEV2.1  
DEPTHTOP OF  
RISER

PROTECTIVE COVER: 4" x 4" Steel

LOCATION: N10707 E9781

GROUND ELEVATION: 794.1 DATUM MSL

DETERMINED BY: Survey

## WELL WATER LEVELS

DATE	DEPTH	REMARKS
1/16	24.9	Before development
1/20	24.5	After development
3/11	23.3	

depth measured from top of riser

RISER TYPE: flush coupled PVC

DIAMETER: 2 IN

LENGTH: 6.6 FT

BACKFILL: bentonite/cement grout

SEAL: bentonite pellets

791.6  
ELEV2.5  
DEPTHTOP OF  
SEAL

below ground surface

790.6  
ELEV3.5  
DEPTHTOP OF  
SAND789.6  
ELEV4.5  
DEPTHTOP OF  
SCREEN

SAND: medium sand (WB40)

SCREEN DIA: 2 IN LENGTH: 25 FT  
TYPE: PVC

SLOT SIZE: 0.01 IN

764.6  
ELEV29.5  
DEPTHBOTTOM  
OF SCREEN763.6  
ELEV29.5  
DEPTHBOTTOM  
OF HOLE

BOREHOLE DIAMETER: 9 IN

DRILL METHOD: 4.25" HSA

REMARKS:

MONITORING WELL DG-2

GEOTECHNOLOGY  
St. Louis, Missouri

DATE INSTALL 1/13/87

DATE DEVELOPED: N/A - Dry

785.8  
ELEV

2.1  
DEPTH

TOP OF  
RISER

PROTECTIVE COVER: 4" x 4" Steel

LOCATION: N9746 E8892

GROUND ELEVATION: 783.7 DATUM: MSL

DETERMINED BY: Survey

# WELL WATER LEVELS

DATE	DEPTH	REMARKS
<u>1/16</u>	<u>44.1</u>	
<u>1/20</u>	<u>44.1</u>	<u>20 Gallons added</u>
<u>1/21</u>	<u>44.6</u>	<u>10 Gallons added</u>

depth measured from top of riser

RISER TYPE: flush coupled PVC

DIAMETER: 2 IN

LENGTH: 30 FT

BACKFILL: bentonite/cement grout

SEAL: bentonite pellets

757.7  
ELEV

26.0  
DEPTH

TOP OF  
SEAL

below ground surface

756.7  
ELEV

27.0  
DEPTH

TOP OF  
SAND

SAND: medium sand (WB40)

755.7  
ELEV

28.0  
DEPTH

TOP OF  
SCREEN

SCREEN DIA: 2 IN LENGTH: 15 FT

TYPE: PVC

SLOT SIZE: 0.01 IN

740.7  
ELEV

43.0  
DEPTH

BOTTOM  
OF SCREEN

BOREHOLE DIAMETER: 9 IN

738.7  
ELEV

45.0  
DEPTH

BOTTOM  
OF HOLE

DRILL METHOD: 4.25" HSA

REMARKS: \_\_\_\_\_

MONITORING WELL DG-3

GEOTECHNOLOGY  
St. Louis, Missouri

DATE INSTAL Y: 1/19/87

DATE DEVELOPED: N/A - Dry

770.2  
ELEV

2.0  
DEPTH

TOP OF  
RISER

PROTECTIVE COVER: 4" x 4" Steel

LOCATION: N10934 E8137

GROUND ELEVATION: 768.2 DATUM: MSL

DETERMINED BY: Survey

WELL WATER LEVELS

DATE	DEPTH	REMARKS
<u>1/21</u>	<u>28.3</u>	
<u>1/21</u>	<u>26.3</u>	<u>After 22 gallons</u>
<u>1/21</u>	<u>27.2</u>	<u>6 Minutes later</u>

depth measured from top of riser

RISER TYPE: flush coupled PVC

DIAMETER: 2 IN

LENGTH: 21 FT

BACKFILL: bentonite/cement grout

SEAL: bentonite pellets

752.5  
ELEV

15.7  
DEPTH

TOP OF  
SEAL

Below ground surface

751.5  
ELEV

16.7  
DEPTH

TOP OF  
SAND

SAND: medium sand (WB40)

749.2  
ELEV

19.0  
DEPTH

TOP OF  
SCREEN

SCREEN DIA: 2 IN LENGTH: 10 FT

TYPE: PVC

SLOT SIZE: 0.01 IN

739.2  
ELEV

29.0  
DEPTH

BOTTOM  
OF SCREEN

BOREHOLE DIAMETER: 9 IN

DRILL METHOD: 4.25" HSA

739.2  
ELEV

29.0  
DEPTH

BOTTOM  
OF HOLE

REMARKS: \_\_\_\_\_

MONITORING WELL DG-4

GEOTECHNOLOGY  
St. Louis, Missouri

DATE INSTALL: 1/19/87

DATE DEVELOPED: 1/19/87

683.1  
ELEV1.1  
DEPTHTOP OF  
RISER

PROTECTIVE COVER: 4" x 4" Steel

LOCATION: N12069 E9185

GROUND ELEVATION: 682 DATUM: MSL

DETERMINED BY: Survey

## WELL WATER LEVELS

DATE	DEPTH	REMARKS
1/19	6.0	After installation
1/19	7.0	After development

depth measured from top of riser

RISER TYPE: flush coupled PVC

DIAMETER: 2 IN

LENGTH: 6.2 FT

BACKFILL: \_\_\_\_\_

682.0  
ELEV0  
DEPTHTOP OF  
SEAL

o Below ground surface

SEAL: cement

679.0  
ELEV3.0  
DEPTHTOP OF  
SAND

SAND: natural sand

671.9  
ELEV5.1  
DEPTHTOP OF  
SCREEN

SCREEN DIA: 2 IN LENGTH: 5 FT

TYPE: PVC

SLOT SIZE: 0.01 IN

671.9  
ELEV10.1  
DEPTHBOTTOM  
OF SCREEN

BOREHOLE DIAMETER: 4 IN

671.6  
ELEV10.4  
DEPTHBOTTOM  
OF HOLE

DRILL METHOD: 4" hand auger and casing

REMARKS: \_\_\_\_\_

MONITORING WELL DG-5

GEOTECHNOLOGY  
St. Louis, Missouri

Surface Elevation <u>780</u> Datum <u>MSL</u>		Completion Date <u>01/16/87</u>		SHEAR STRENGTH, 1sf					
DEPTH IN FEET		DESCRIPTION OF MATERIAL	UNIT DRY WEIGHT SPT VALUE	SAMPLES	$\Delta$ - UU/2	O - QU/2	$\diamond$ - SV		
					0.5	1.0	1.5	2.0	2.5
					STANDARD PENETRATION RESISTANCE (ASTM D 1586) $\Delta$ - BLOWS PER FOOT				
				WATER CONTENT, %		PL - LLL			
				10		20			
				30		40			
				50					
		Tan to gray, very loose to loose slightly silty fine SAND becoming gray and more silty below 14 feet		SS	$\Delta$				
				SS	$\Delta$				
				SS	$\Delta$	O	Grain Size Analysis		
				SS	$\Delta$				
				SS	$\Delta$				
			Intermixed gray, loose to medium dense, silty clayey SAND, to sandy clayey SILT		SS	$\Delta$	O	Grain Size Analysis	
				SS	$\Delta$				
				SS	$\Delta$	O	Grain Size Analysis		
		Auger refusal on SANDY DOLOMITE at 37.5 feet							

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL

# GROUNDWATER DATA

# DRILLING DATA

ENCOUNTERED AT 23.5 FEET  
AT \_\_\_\_\_ FEET AFTER \_\_\_\_\_ HOURS  
AT \_\_\_\_\_ FEET AFTER \_\_\_\_\_ HOURS  
FREE WATER NOT ENCOUNTERED DURING DRILLING

AUGER 9" HOLLOW STEM  
WASH BORING FROM \_\_\_\_\_ FEET  
MM DRILLER KDD LOGGER  
CME SS DRILL RIG

REMARKS: PVC monitoring well casing installed

# LOG OF BORING

UG-1

# GEOTECHNOLOGY

St. Louis, Missouri

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

**NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.**

## DRILLING DATA

AUGER 9" HOLLOW STEM

WASH CORE FROM FEET

MM DRILLER KPO LOGGER

CME 55 DRILL RIG

REMARKS: PVC monitoring well casing installed

LOG OF BORING

DG-1

# GEOTECHNOLOGY

**St. Louis, Missouri**



CONTINUATION OF BORING DG-1		SURFACE ELEVATION <u>784</u>		SHEAR STRENGTH, 1sf $\Delta$ -UU/2 $\circ$ -qu/2 $\diamond$ -qv 0.5    1.0    1.5    2.0    2.5		
DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WEIGHT SPT VALUE	SAMPLES	STANDARD PENETRATION RESISTANCE (ASTM D 1586) $\Delta$ -BLOWS PER FOOT WATER CONTENT, % PL    10    20    30    40    50    LL		
				89	Gray, very loose, sandy and clayey SILT with green and black organics at 99 feet	
90			SS $\Delta$		$\circ$	
91			SS $\Delta$			
92			SS $\Delta$			
100	TERMINATED AT 100' DUE TO INSTABILITY OF TAILINGS		SS $\Delta$			
110						
120						
130						
140						
150						
160						
170						

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

GEOTECHNOLOGY  
St. Louis, Missouri



Surface Elevation 784Datum MSLCompletion Date 01/13/87

SHEAR STRENGTH, 1sf

 $\Delta$ -UU/2     $\circ$ -QU/2     $\diamond$ -SV

0.5    1.0    1.5    2.0    2.5

STANDARD PENETRATION RESISTANCE  
(ASTM D 1586) $\Delta$ -BLOWS PER FOOT

WATER CONTENT, %

PL    10    20    30    40    50    LL

DEPTH  
IN FEET

## DESCRIPTION OF MATERIAL

UNIT DRY WEIGHT  
SPT VALUE

SAMPLES

Tan. loose to medium dense,  
fine to medium. SILT and silty SAND

SS

SS

SS

SS

SS

SS

SS

SS

SS

Grain Size  
AnalysisBrown gray. loose. fine gravelly SAND  
with wood and black organics

SS

Grain Size  
AnalysisBrown. medium stiff. silty CLAY  
with sandy DOLOMITE fragments

SS

Grain Size  
Analysis

Boring terminated at 45 feet

## GROUNDWATER DATA

## DRILLING DATA

ENCOUNTERED AT 33 FEETAUGER 9" HOLLOW STEM

AT \_\_\_\_\_ FEET AFTER \_\_\_\_\_ HOURS

WASH BORING FROM \_\_\_\_\_ FEET

AT \_\_\_\_\_ FEET AFTER \_\_\_\_\_ HOURS

MM DRILLER KDD LOGGERFREE WATER NOT ENCOUNTERED  
DURING DRILLINGCME SS DRILL RIG

## LOG OF BORING

REMARKS: PVC monitoring well casing installed

DG-3

GEOTECHNOLOGY

St. Louis, Missouri

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES  
BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

Surface Elevation 768Completion Date 01/19/87Datum MSLDEPTH  
IN FEET

## DESCRIPTION OF MATERIAL

UNIT DRY WEIGHT  
SPT VALUE

SAMPLES

SHEAR STRENGTH,  $\text{lb/ft}^2$  $\Delta$  -  $uu/2$      $\circ$  -  $qu/2$      $\diamond$  -  $sv$ 

0.5    1.0    1.5    2.0    2.5

STANDARD PENETRATION RESISTANCE  
(ASTM D 1586) $\Delta$  - BLOWS PER FOOT

WATER CONTENT, %

PL 10 20 30 40 50 1LL

Tan. loose to medium dense SAND

SS

 $\Delta$ Grain Size  
Analysis

SS

 $\circ$  $\Delta$ 

SS

 $\Delta$ 

SS

 $\Delta$ Grain Size  
Analysis

SS

 $\circ$  $\Delta$ 

5-8"

Brown silty CLAY with dolomite  
fragments

Split spoon refusal at 29 feet

## GROUNDWATER DATA

## DRILLING DATA

ENCOUNTERED AT 24 FEETAUGER 9" HOLLOW STEMAT        FEET AFTER        HOURSWASH DURING FROM        FEETAT        FEET AFTER        HOURSMM DRILLER KDD LOGGERFREE WATER: NOT ENCOUNTERED  
DURING DRILLINGCME SS DRILL RIGREMARKS: PVC monitoring well casing installed

LOG OF BORING

DG-4

GEOTECHNOLOGY

St. Louis, Missouri

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

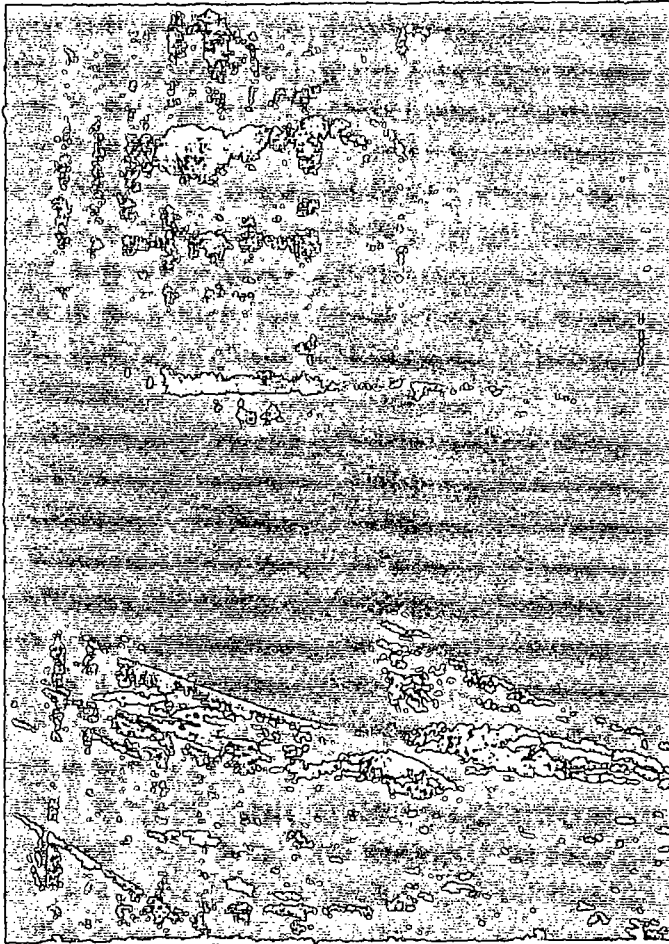
NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES  
BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

## APPENDIX C

### Photo Documentation of Site

ECOLOGY & ENVIRONMENT, INC.  
PHOTOGRAPHIC RECORD

SITE



No.: C-1

Subject Big River with mine tailing dust  
rising from the pile.

Photographer

Robert Overfelt

Witness

Gene Gunn

Date/Time

January 25, 1988 1030 hrs

Direction

North

No.: C-2

Subject

Area where mine  
tailings slope  
are in contact  
with the Big River

Photographer

Robert Overfelt

Witness

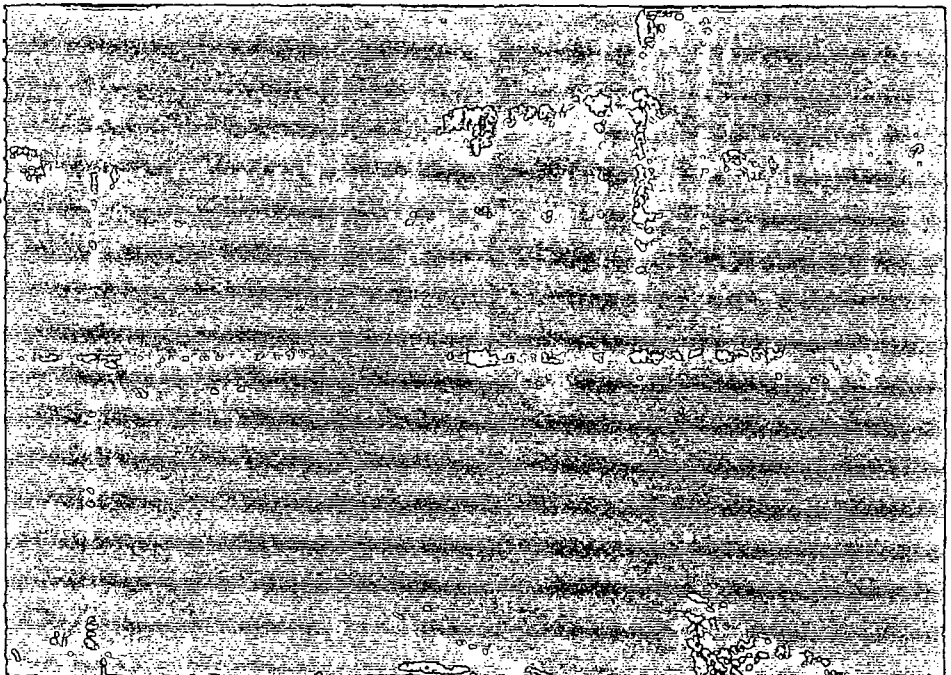
Gene Gunn

Date/Time

January 25, 1988  
1030 hrs

Direction

North



ECOLOGY & ENVIRONMENT, INC.  
PHOTOGRAPHIC RECORD

SITE

No.: C-3

Subject

Gap A from edge  
of River after  
filled

Photographer

Bob Overfelt

Witness

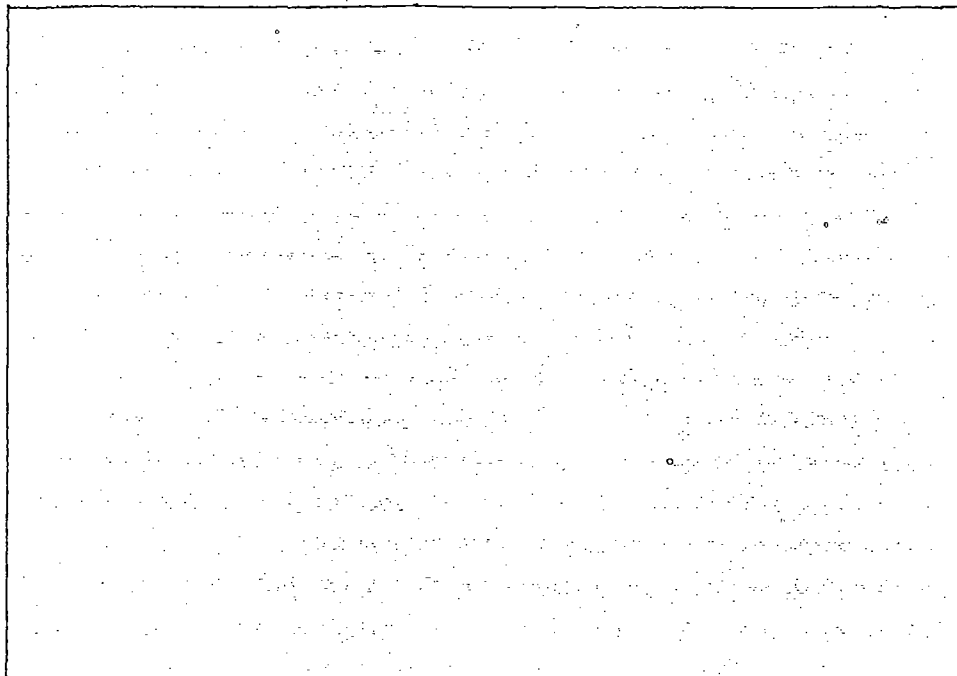
Gene Gunn

Date/Time

January 25, 1988

Direction

West



No.: C-4

Subject

Wind fencing  
Box configuration

Photographer

Bob Overfelt

Witness

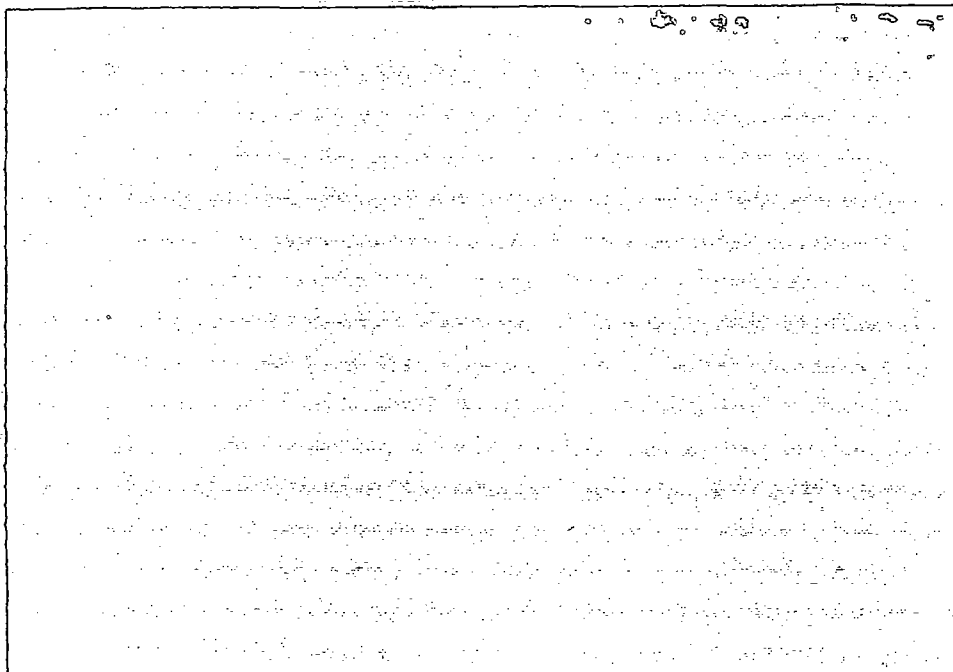
Gene Gunn

Date/Time

January 25, 1988

Direction

Southeast



ECOLOGY & ENVIRONMENT, INC.  
PHOTOGRAPHIC RECORD

SITE

No.: C-5  
Subject Wind

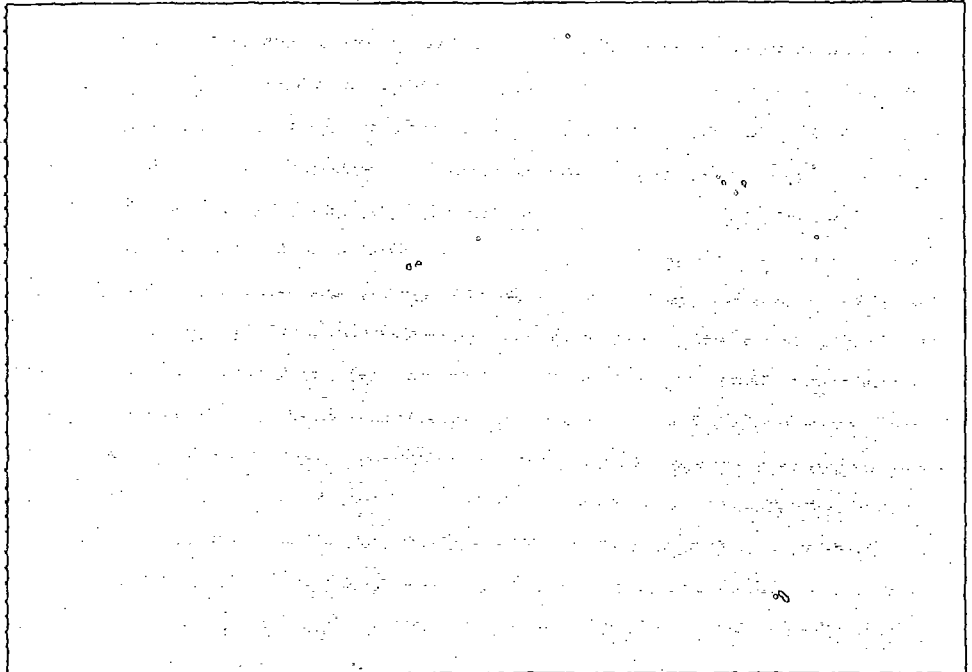
Fencing showing tail-  
ings accumulation.

Photographer  
Bob Overfelt

Witness  
Gene Gunn

Date/Time  
January 25, 1988  
1100 hrs  
Direction

Southwest



No.: C-6  
Subject Trees

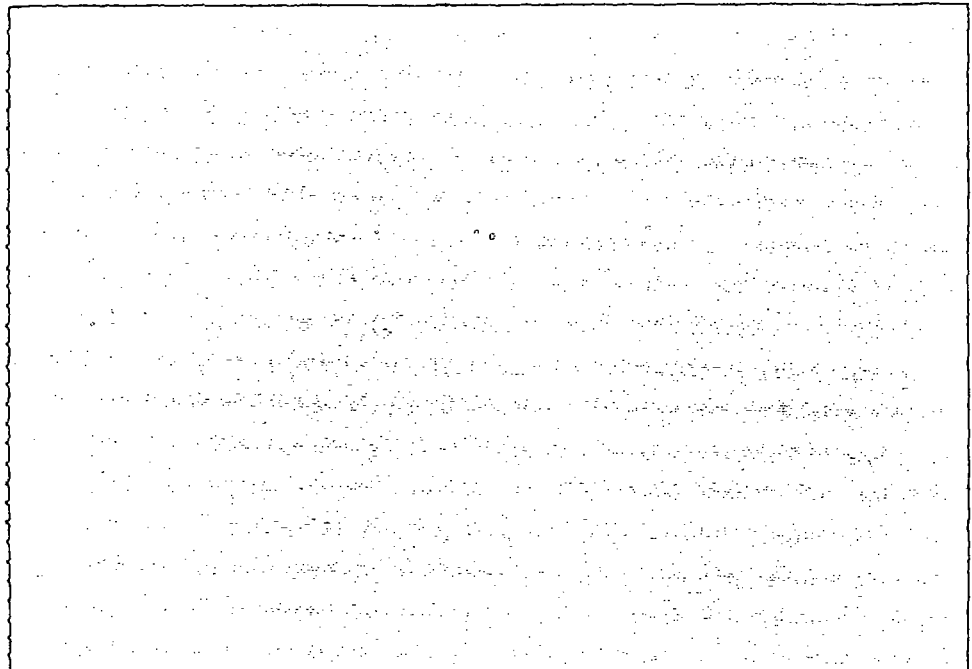
Planted on north  
side.

Photographer  
Bob Overfelt

Witness  
Gene Gunn

Date/Time  
January 25, 1988  
1100 hrs  
Direction

West





ECOLOGY & ENVIRONMENT, INC.  
PHOTOGRAPHIC RECORD

SITE

No.: C-7

Subject

Trees planted on  
north side.

Photographer

Bob Overfelt

Witness

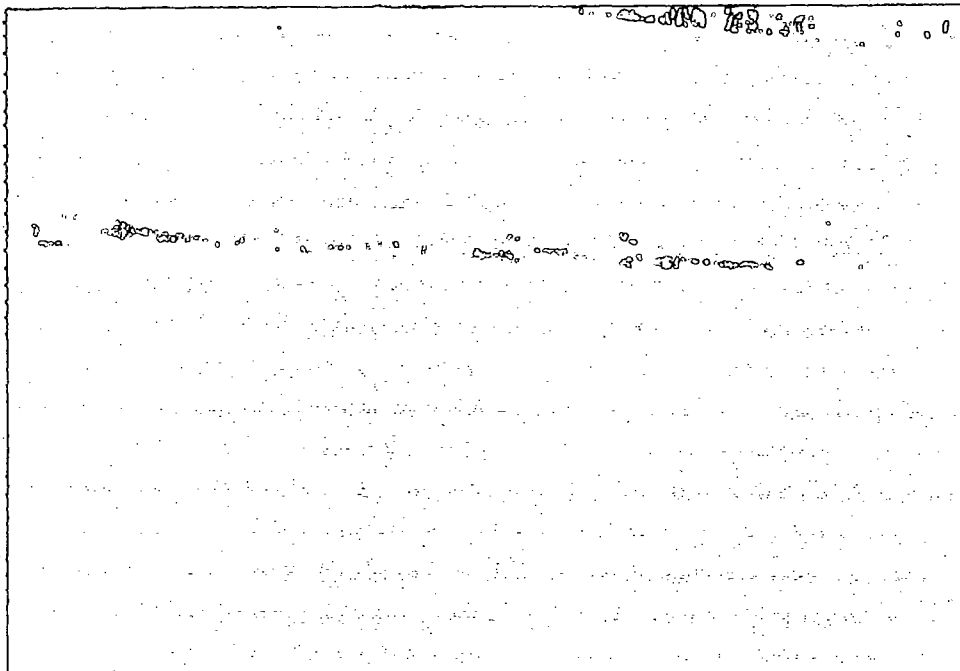
Gene Gunn

Date/Time

January 25, 1988

1100 hrs  
Direction

Southwest



No.: C-8

Subject

"H" Gap filled

Photographer

Bob Overfelt

Witness

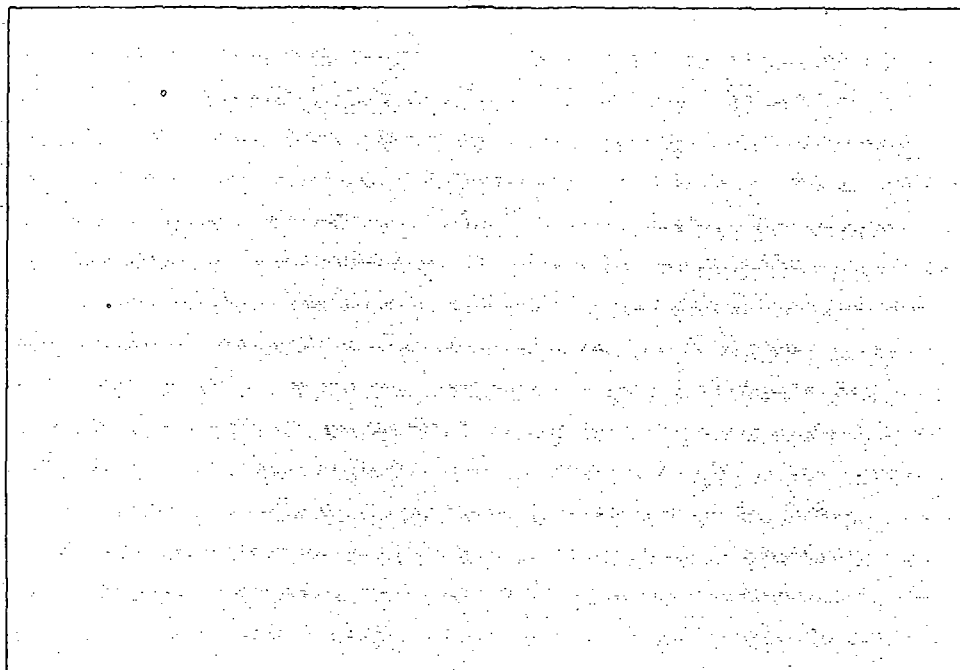
Gene Gunn

Date/Time

January 25, 1988

1120 hrs  
Direction

Northeast



ECOLOGY & ENVIRONMENT, INC.  
PHOTOGRAPHIC RECORD

SITE

No.: C-9

Subject

Trees & grass planted  
on west side of pile  
near gap I

Photographer

Bob Overfelt  
Witness

Gene Gunn

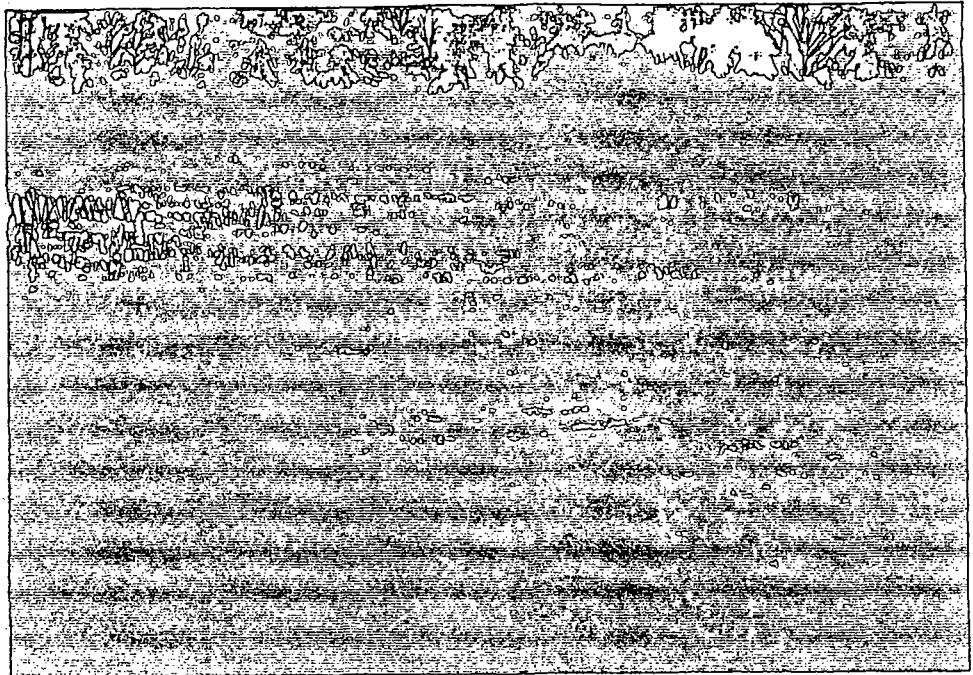
Date/Time

January 25, 1988

1130 hrs

Direction

Northeast



No.: C-10

Subject

Berm with Gap "I"  
drainage pipe.

Photographer

Bob Overfelt  
Witness

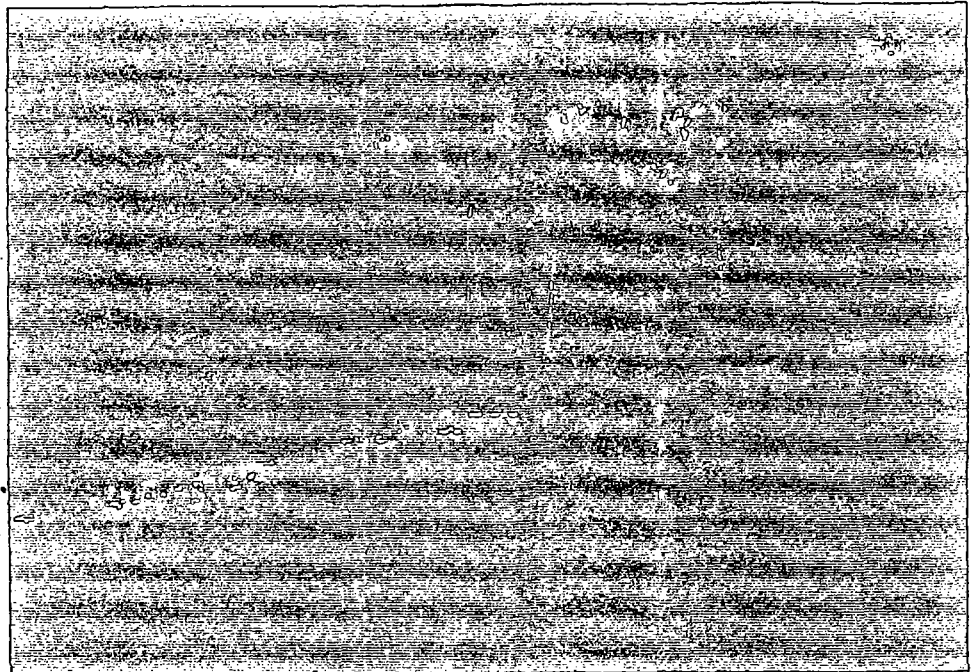
Gene Gunn

Date/Time

January 25, 1988 1200 hrs.

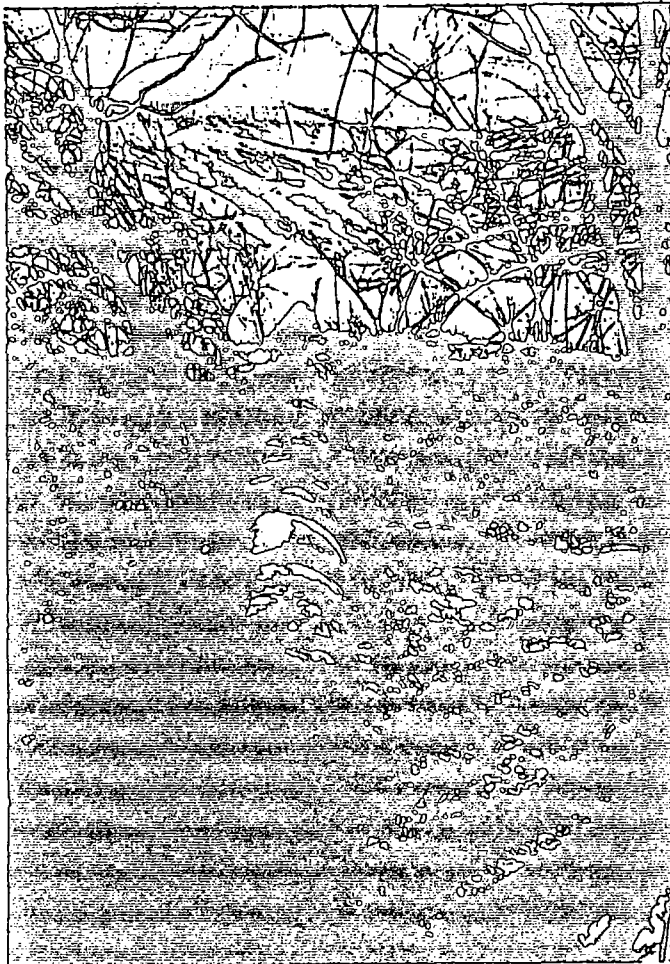
Direction

North



ECOLOGY & ENVIRONMENT, INC.  
PHOTOGRAPHIC RECORD

SITE



No.: C-11

Subject Gap "I" drainage pipe from  
Big River.

Photographer

Bob Overfelt

Witness

Gene Gunn

Date/Time

January 25, 1988 1230 hrs.

Direction

East

No.: C-12

Subject

West side where tailings  
meet river.

Photographer

Bob Overfelt

Witness

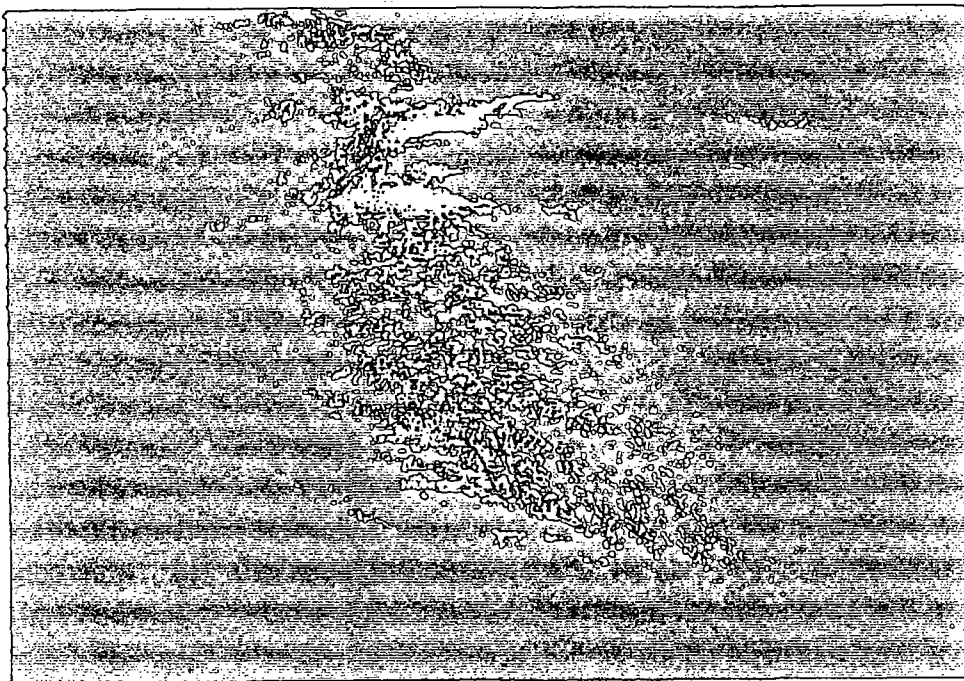
Gene Gunn

Date/Time

January 25, 1988 1245 hrs.

Direction

Southwest



ECOLOGY & ENVIRONMENT, INC.  
PHOTOGRAPHIC RECORD

SITE

No.: C-13

Subject

Cut back of river where tailings  
meet river.

Photographer

Bob Overfelt

Wetland

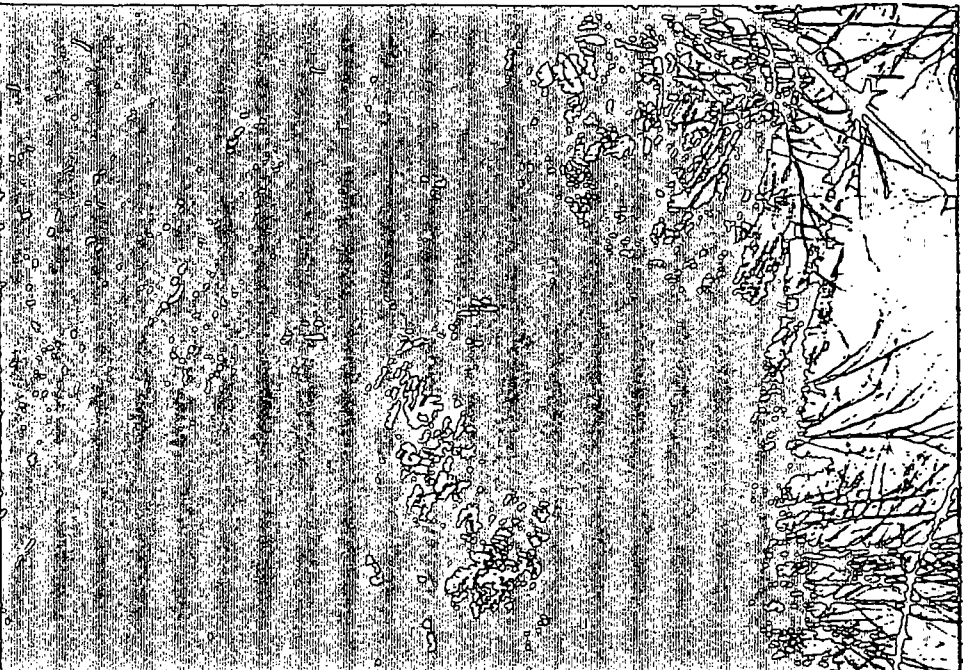
Gene Gunn

Date/Time

January 25, 1988 1250 hrs.

Direction

Southeast



No.: C-14

Subject

Original drainage  
structure.

Photographer

Bob Overfelt

Wetland

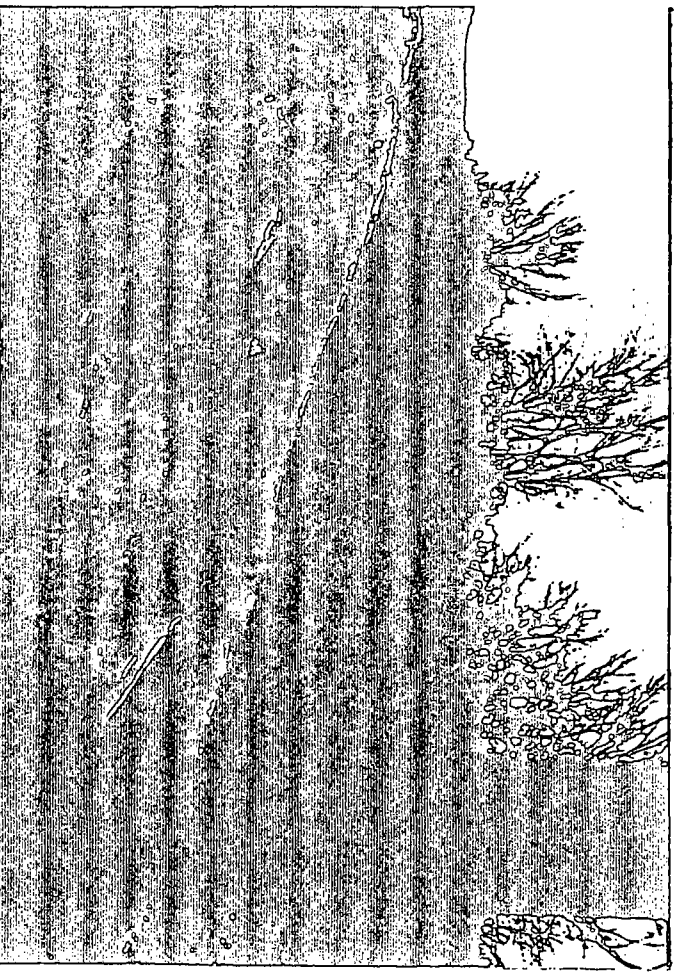
Gene Gunn

Date/Time

January 25, 1988 1300 hrs.

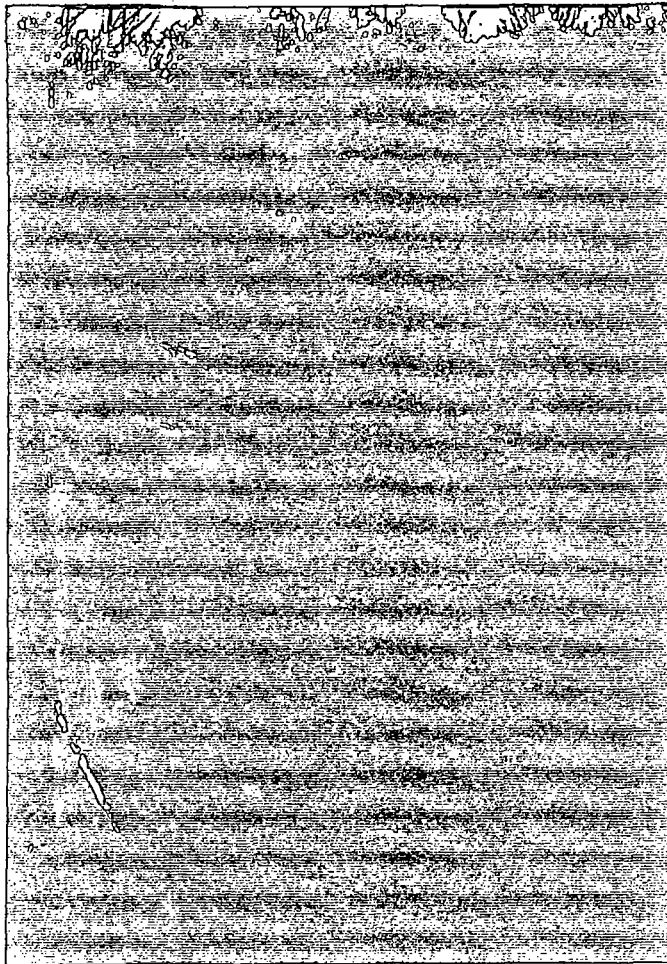
Direction

Southwest



ECOLOGY & ENVIRONMENT, INC.  
PHOTOGRAPHIC RECORD

SITE



No.: C-15

Subject

Gap "E" showing tailings and  
bedrock.

Photographer

Bob Overfelt

Witness

Gene Gunn

Date/Time

January 25, 1988 1320 hrs.

Direction

Southeast

No.: C-16

Subject

Gap "E" draining tail-  
ings toward river.

Photographer

Bob Overfelt

Witness

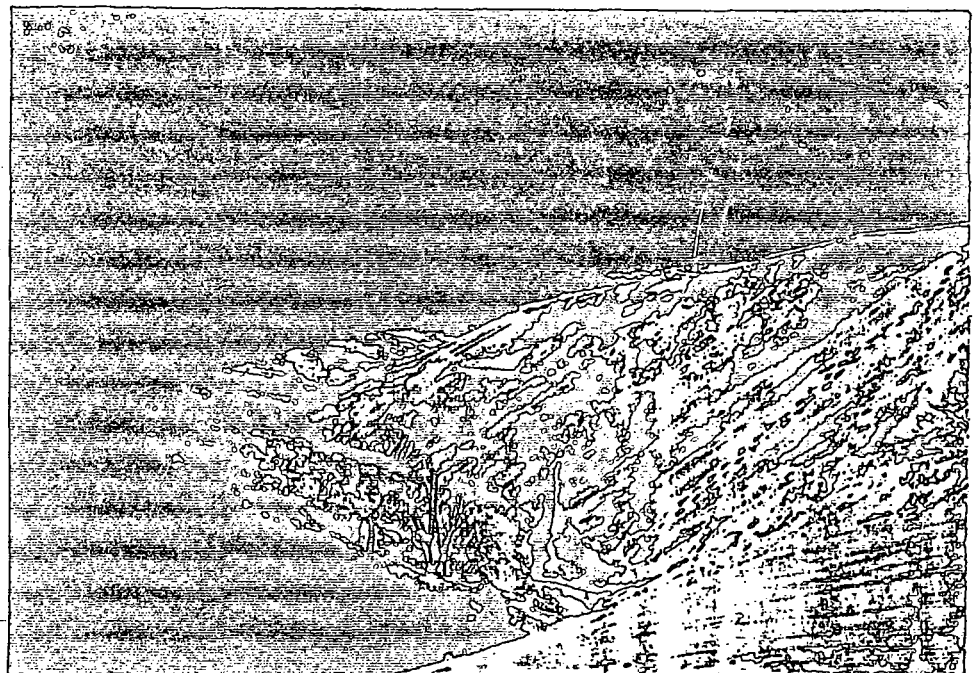
Gene Gunn

Date/Time

January 25, 1988 1325 hrs.

Direction

West





ECOLOGY & ENVIRONMENT, INC.  
PHOTOGRAPHIC RECORD

SITE

No.: C-17

Subject

Dam above Gap "E"

Photographer

Bob Overfelt

Witness

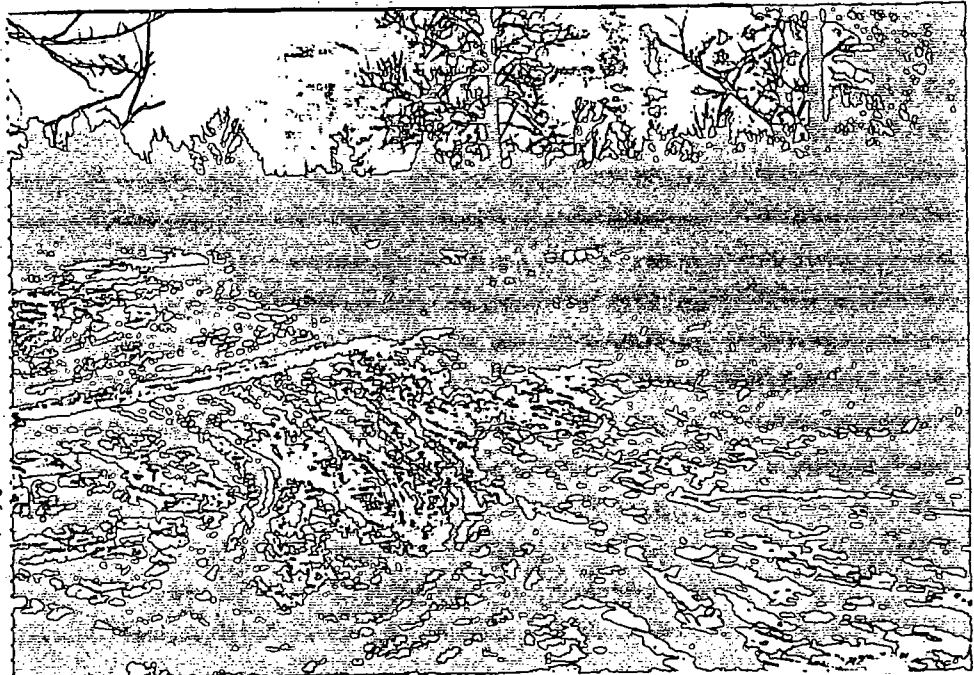
Gene Gunn

Date/Time

January 25, 1988 1330 hrs.

Direction

Southwest



No.:

Subject

Photographer

END OF PHOTOGRAPHIC RECORD

Witness

Date/Time

Direction

**APPENDIX D**

**Sample Results Heavy Metals in  
Desloge Tailings Pile**

CONCENTRATIONS OF LEAD, CADMIUM, AND ZINC FROM SAMPLES  
TAKEN AT THE BIG RIVER-DESLOGE TAILINGS PILE

Sample No.	Metal Conc; ug/g		
	Pb	Cd	Zn
D900	1670	37.8	1670
D901	1540	38.9	1700
D902	1420	27.4	1150
D903	1190	11.7	330
D904	1420	54.8	2380
D905	2590	30.2	1320
D906	3840	34.9	1750
D907	3560	26.5	1380
D908	970	6.8	875
D909	1250	15.6	950
D910	1800	15.7	1040
D911	1360	25	1080
D912	2310	40.0	1890
D913	4470	18.3	821
D915	1530	13.8	680
D916	826	15.7	531
D917	3140	31.7	1440
D918	1020	17.4	637
D919	958	21.4	798
D920	2710	29.9	1380
D921	1570	8.0	511
D922	997	7.0	406
D923	835	8.0	373
D924	896	7.5	437
D925	1310	9.8	373
D926	1080	13	297
D927	983	11.8	354
D928	877	16.5	518
D929	964	13.8	373
D930	1360	15.0	582
D931	1010	18.5	698
D932	1150	21.5	816
D933	951	11.6	233
D934	1620	20.5	840
D935	5530	46.9	404
D936	1570	24.2	933
D937	1400	8.7	525
D938	1330	19.8	733
D939	1140	21.5	783
D940	2380	19.2	1380
D941	1120	9.2	558
D942	1410	15.4	715
D943	4320	68.2	3580
D944	1800	15.8	1210
D945	1710	21.1	1090

FROM: WIXON, B.G., ETAL. UNIVERSITY OF MISSOURI-ROLLA, A STUDY OF CHAT AND TAILINGS  
FROM THE OLD LEAD BELT OF MISSOURI FOR AGRICULTURAL LIMESTONE. DECEMBER, 1983.



Sample No.	Metal Conc.: ug/g		
	Pb	Cd	Zn
D946	3190	17.5	1350
D947	933	12.0	344
D948	1440	13.5	439
D949	2380	18.1	644
D950	1730	15.9	693
D951	1540	55.9	519
D952	1490	7.7	560
D953	1070	24.5	1030
D954	4710	31.4	1510
D955	2780	30.7	1570
D956	5360	28.8	1330
D957	6200	37.3	1720
D958	2910	37.1	1680
D960	1880	35.8	3990
D961	1830	39.4	3080
D962	1950	38.9	2910
D963	1410	32.9	1970
D964	2180	45.6	2500
D965	2130	43.8	1780
D967	1980	37.8	1720
D968	2310	37.9	1870
D969	1810	25.6	1100
D970	3610	38.2	1850
D971	5822	46.2	2250
D972	2240	22.9	994
D973	4070	44.5	2090
D974	2110	33.6	1560
D975	3130	51.6	2410
D976	2690	78.6	3970

SECTION 7: REFERENCES

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2. Emergency Action Plan for Lead Mine Tailings Desloge, Missouri, Draft, 1981.
3. Hudwalker, Marvin, February 2, 1988, personal communication, Professional Engineer, Hudwalker and Associates, Inc., Farmington, Missouri.
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5. Aubuchon, Bryant, December 1, 1987, personal communication, Streams Impacted by Lead Mining, Missouri Department of Conservation.
6. Czarneski, James, 1984, Accumulation of Lead in Fish from Missouri from Missouri's Old Lead Belt.
7. Gale, N. etal, Lead Concentrations in Edible Fish Fillets Collected
8. Mattson, C., November 13, 1987, personal communication, Project Manager, St. Joe Minerals Corporation, Irvine, California.
9. Burris, James, February 1, 1988, personal communication, Project Bluff, Missouri.
10. Burns & McDonnell Engineers, Desloge Tailings Pile Management Plan Study Phase I Report, February 1, 1987.
11. Herschlach, Robert, April 13, 1987, Resource Conservation, Soil Administration, MDNR-Poplar Bluff, Missouri.
12. Wixon, B.G., etal, University of Missouri-Rolla, A Study of the Possible use of Chat and Tailings from the Old Lead Belt of Missouri for Agriculture Limestone, December 1983.
13. Quality Criteria for Water, U.S. Environmental Protection Agency, July 1976.
14. EPA Regulatory Status for Chemicals in Drinking Water, July 1987, to 51, July 1, 1987.
15. Code of Federal Regulations, Protection of Environment 40, Parts 1

16. Schmitt, C. and Finger S., 1982, The Dynamics of Metals from Past Present Mining Activities in the Big and Black River Watersheds, Southeastern Missouri.
17. Gale, Nord, etal, Historical Trends for Lead in Fish, Clams and Sediments in the Big River of Southeastern Missouri, University of Missouri-Rolla.
18. Air Quality Data at Flat River, Missouri, 1981, 1982, 1983, Missouri Department of Natural Resources.
19. Climatic Atlas of The United States, 1979 United States Department of Commerce.
20. Soil Survey of St. Francois County, Missouri, August 1981, National Cooperative Soil Survey.
21. Buckley, E.R., 1908 Geology of the Disseminated Lead Deposits of St. Francois and Washington Counties: Missouri's Bureau of Geology and Mines, 2nd Ser., Vol 8, PA. 1.
22. Missouri Division of Geological Survey and Water Resources, 1861, The Stratigraphic Succession in Missouri.
23. Missouri Division of Geological Survey and Water Resources, 1983, Ground Water Maps of Missouri.
24. Johnson, Dennis, December 2, 1987, personal communication, Assistant Manager Water District Flat River, Missouri.
25. Wixson, B. G., etal, Influence of Tailings from the Old Lead Belt of Missouri on Sediments of the Big River, University of Missouri-Rolla.
26. Rand McNally's Road and Reference Atlas, 1982.

APPENDIX A

EPA Form 2070-12

POTENTIAL HAZARDOUS WASTE SITE		I. IDENTIFICATION	
PRELIMINARY ASSESSMENT		01 STATE	02 SITE NUMBER
PART 1 - SITE INFORMATION AND ASSESSMENT		MO	D981126899
SITE NAME AND LOCATION			
SITE NAME (Legal, common, or descriptive name of site) River Mine Tailings		02 STREET, ROUTE NO., OR SPECIFIC LOCATION IDENTIFIER Approximately 1 mile northwest of Desloge, Missouri	
TYPE Other		04 STATE MO	05 ZIP CODE 63601
06 COUNTY St. Francois		07 COUNTY CODE	08 CONG DIST
ORDINATES 53° 11' 4N		LONGITUDE 90° 33' 00" 0W	
DIRECTIONS TO SITE (Starting from nearest public road) Hwy 67 south to Desloge. From Desloge the site is approximately 1 mile northwest and is bordered by a district of the Big River on its west, north, and east sides.			
RESPONSIBLE PARTIES			
OWNER (If known) St. Francois County		02 STREET (Business, mailing, residential)	
TYPE Other		04 STATE MO	05 ZIP CODE 63601
06 TELEPHONE NUMBER (314) 431-6505			
OPERATOR (If known and different from owner) St. Francois County Environmental Corp.		08 STREET (Business, mailing, residential)	
TYPE Other		10 STATE MO	11 ZIP CODE 63601
12 TELEPHONE NUMBER (314) 431-4768			
TYPE OF OWNERSHIP (Check one) <input type="checkbox"/> A. PRIVATE <input type="checkbox"/> B. FEDERAL: _____ <input type="checkbox"/> C. STATE <input checked="" type="checkbox"/> D. COUNTY <input type="checkbox"/> E. MUNICIPAL (Agency name) <input type="checkbox"/> F. OTHER: _____ <input type="checkbox"/> G. UNKNOWN (Specify)			
OWNER/OPERATOR NOTIFICATION ON FILE (Check all that apply) RCRA 3001 DATE RECEIVED: _____ B. UNCONTROLLED WASTE SITE (CERCLA 103 c) DATE RECEIVED: _____ C. NONE MO/DAY/YR MO/DAY/YR			
CHARACTERIZATION OF POTENTIAL HAZARD			
SITE INSPECTION BY (Check all that apply) <input checked="" type="checkbox"/> YES DATE 1/25/88 <input checked="" type="checkbox"/> A. EPA <input checked="" type="checkbox"/> B. EPA CONTRACTOR <input type="checkbox"/> C. STATE <input type="checkbox"/> D. OTHER CONTRACTOR NO MO/DAY/YR <input type="checkbox"/> E. LOCAL HEALTH OFFICIAL <input type="checkbox"/> F. OTHER: _____ (Specify) CONTRACTOR NAME(S): E & E/FIT			
SITE STATUS (CHECK ONE) <input type="checkbox"/> A. ACTIVE <input checked="" type="checkbox"/> B. INACTIVE <input type="checkbox"/> C. UNKNOWN		03 YEARS OF OPERATION 1929 1958 UNKNOWN BEGINNING YEAR ENDING YEAR	
DESCRIPTION OF SUBSTANCES POSSIBLY PRESENT, KNOWN, OR ALLEGED Tailings which contain a mean value of 2,077 ppm lead (Pb), 26 ppm Cadmium (Cd) and 1,226 ppm zinc (Zn). Tailings cover approximately 600 acres at a depth of 0-100 feet within a "horse shoe" of the Big River.			
DESCRIPTION OF POTENTIAL HAZARD TO ENVIRONMENT AND/OR POPULATION Leakage of tailings into the Big River. Potential health hazard from the dispersion of lead laden dust in the air. Potential for landfill organic chelating agents to solubilize and mobilize Pb, Zn, and Cd.			
PRIORITY ASSESSMENT			
PRIORITY FOR INSPECTION (Check one. If high or medium is checked, complete Part 2 - Waste Information and Part 3 - Description of Hazardous Conditions and Incidents) <input type="checkbox"/> A. HIGH <input type="checkbox"/> B. MEDIUM <input type="checkbox"/> C. Low <input type="checkbox"/> D. NONE Inspection required (Inspection required) (Inspect on time available basis) (No further action needed. Complete current disposition form)			
INFORMATION AVAILABLE FROM			
CONTACT Gunn		02 OF (Agency/Organization) EPA Superfund Branch	
PERSON RESPONSIBLE FOR ASSESSMENT Overfelt		05 AGENCY E & E	06 ORGANIZATION FIT
		07 TELEPHONE NUMBER 913-432-9961	08 DATE 4/27/88 MO/DAY/YR

## POTENTIAL HAZARDOUS WASTE SITE

## PRELIMINARY ASSESSMENT

## PART 2 - WASTE INFORMATION

## I. IDENTIFICATION

01 STATE  
MO02 SITE NUMBER  
D981126899

## WASTE STATES, QUANTITIES, AND CHARACTERISTICS

01 WASTE STATES (Check all that apply) <input checked="" type="checkbox"/> SOLID <input type="checkbox"/> E. SLURRY <input type="checkbox"/> POWDER, FINES <input type="checkbox"/> F. LIQUID <input type="checkbox"/> SLUDGE <input type="checkbox"/> G. GAS <input type="checkbox"/> OTHER _____ (Specify)	02 WASTE QUANTITY AT SITE (Measures of waste quantities must be independent) TONS _____ CUBIC YARDS ~ 4 million NO. OF DRUMS _____	03 WASTE CHARACTERISTICS (Check all that apply) <input checked="" type="checkbox"/> A. TOXIC <input type="checkbox"/> E. SOLUBLE <input type="checkbox"/> I. HIGHLY VOLATILE <input type="checkbox"/> B. CORROSIVE <input type="checkbox"/> F. INFECTIOUS <input type="checkbox"/> J. EXPLOSIVE <input type="checkbox"/> C. RADIOACTIVE <input type="checkbox"/> G. FLAMMABLE <input type="checkbox"/> K. REACTIVE <input type="checkbox"/> D. PERSISTENT <input type="checkbox"/> H. IGNITABLE <input type="checkbox"/> L. INCOMPATIBLE <input type="checkbox"/> M. NOT APPLICABLE
--	--	---

## WASTE TYPE

01 WASTE TYPE	02 SUBSTANCE NAME	03 GROSS AMOUNT	04 UNIT OF MEASURE	05 COMMENTS
	SLUDGE			
	OILY WASTE			
	SOLVENTS			
	PESTICIDES			
	OTHER ORGANIC CHEMICALS			
	INORGANIC CHEMICALS			
	ACIDS			
	BASES			
	HEAVY METALS	Unknown		Lead, Zinc, Cadmium

## HAZARDOUS SUBSTANCES (See Appendix for most frequently cited CAS Numbers)

01 CATEGORY	02 SUBSTANCE NAME	03 CAS NUMBER	04 STORAGE/DISPOSAL METHOD	05 CONCENTRATION	06 MEASURE OF CONCENTRATION
	Lead	7439921	mine tailings pile	mean 2,077	ug/g
	Zinc	7440-66-6	mine tailings pile	mean 1,226	ug/g
	Cadmium	7440439	mine tailings pile	mean 26	ug/g
	Copper	7440508	mine tailings pile	Unknown	

## FEEDSTOCKS (See Appendix for CAS Numbers)

01 CATEGORY	02 FEEDSTOCK NAME	03 CAS NUMBER	04 CATEGORY	05 FEEDSTOCK NAME	06 CAS NUMBER
FDS			FDS		
FDS			FDS		
FDS			FDS		
FDS			FDS		

## SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

Agency Action Plan for Lead Mine Tailings, Desloge, Missouri, Draft EPA files. A study on the possible use of lead and tailings from the old Lead Belt of Missouri for Missouri for Agricultural Limestone, University of Missouri - Rolla. Dangerous Properties of Industrial Materials 6th Ed. N. Irving Sax.

## POTENTIAL HAZARDOUS WASTE SITE

## PRELIMINARY ASSESSMENT

## I. IDENTIFICATION

01 STATE MO 02 SITE NUMBER D981126899

## PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

## HAZARDOUS CONDITIONS AND INCIDENTS

A. GROUNDWATER CONTAMINATION	02	OBSERVED (DATE: )	X	POTENTIAL	ALLEGED
POPULATION POTENTIALLY AFFECTED:	04	NARRATIVE DESCRIPTION			
There is potential for ground water contamination from surface water because faults exist in the site area. The on-landfill may release organic chelating agents which could release heavy metals into the ground water.					
B. SURFACE WATER CONTAMINATION	02	OBSERVED (DATE: )		POTENTIAL	ALLEGED
POPULATION POTENTIALLY AFFECTED:	04	NARRATIVE DESCRIPTION			
The site and several miles downstream the bottom of the Big River is lined with mine tailings. This has raised Pb and Zn levels slightly in the water. There is potential for more mine tailings to erode into the river.					
C. CONTAMINATION OF AIR	02	OBSERVED (DATE: )	X	POTENTIAL	ALLEGED
POPULATION POTENTIALLY AFFECTED:	04	NARRATIVE DESCRIPTION			
Laden dust blows off the top of the mine tailings pile.					
D. FIRE/EXPLOSIVE CONDITIONS	02	OBSERVED (DATE: )		POTENTIAL	ALLEGED
POPULATION POTENTIALLY AFFECTED:	04	NARRATIVE DESCRIPTION			
None known or reported to date					
E. DIRECT CONTACT	02	OBSERVED (DATE: )		POTENTIAL	ALLEGED
POPULATION POTENTIALLY AFFECTED:	04	NARRATIVE DESCRIPTION			
People are currently and have in the past driven all terrain vehicles (ATVs) on the mine tailings pile for recreation. Also landfill workers are exposed to the tailings daily.					
F. CONTAMINATION OF SOIL	02	OBSERVED (DATE: )		POTENTIAL	ALLEGED
AREA POTENTIALLY AFFECTED: 600	04	NARRATIVE DESCRIPTION			
(Acres.)					
Mine tailings cover approximately 600 acres.					
G. DRINKING WATER CONTAMINATION	02	OBSERVED (DATE: )		POTENTIAL	ALLEGED
POPULATION POTENTIALLY AFFECTED:	04	NARRATIVE DESCRIPTION			
None known or reported to date					
H. WORKER EXPOSURE/INJURY	02	OBSERVED (DATE: )		POTENTIAL	ALLEGED
WORKERS POTENTIALLY AFFECTED:	04	NARRATIVE DESCRIPTION			
None known or reported to date					
I. POPULATION EXPOSURE/INJURY	02	OBSERVED (DATE: )		POTENTIAL	ALLEGED
POPULATION POTENTIALLY AFFECTED:	04	NARRATIVE DESCRIPTION			
None known or reported to date					

## PRELIMINARY ASSESSMENT

01 STATE MO 02 SITE NUMBER D981126899

## PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

## HAZARDOUS CONDITIONS AND INCIDENTS (CONTINUED)

J. DAMAGE TO FLORA 02 ☒ OBSERVED (DATE: 1/25/88) ☐ POTENTIAL ☐ ALLEGED

## NARRATIVE DESCRIPTION

Natural recovery of vegetation has occurred. The 600 acres of mine tailings are virtually bare.

K. DAMAGE TO FAUNA 02 ☐ OBSERVED (DATE: ) ☐ POTENTIAL ☐ ALLEGED

## NARRATIVE DESCRIPTION (Include name(s) of species)

Elevated levels of Pb, Cd, and Zn were found in a study that examined algae.

L. CONTAMINATION OF FOOD CHAIN 02 ☐ OBSERVED (DATE: ) ☐ POTENTIAL ☐ ALLEGED

## NARRATIVE DESCRIPTION

Bottom feeding fish in the Big River are known to have elevated levels of Pb in their edible tissue. Fish are not safe for human consumption through sport fishing from the Big River.

M. UNSTABLE CONTAINMENT OF WASTES 02 ☒ OBSERVED (DATE: 1977) ☐ POTENTIAL ☐ ALLEGED

Spills/runoff/standing liquids/leaking drums)

POPULATION POTENTIALLY AFFECTED: 04 NARRATIVE DESCRIPTION

Leakage of mine tailings into the Big River.

N. DAMAGE TO OFFSITE PROPERTY 02 ☒ OBSERVED (DATE: 1977) ☐ POTENTIAL ☐ ALLEGED

## NARRATIVE DESCRIPTION

Big River bottom is lined with mine tailings for several miles downstream from the site and the biota in the river contain elevated Pb, Cd, and Zn levels.

O. CONTAMINATION OF SEWERS, STORM DRAINS, WWTPs 02 ☐ OBSERVED (DATE: ) ☐ POTENTIAL ☐ ALLEGED

## NARRATIVE DESCRIPTION

None known or reported to date

P. ILLEGAL/UNAUTHORIZED DUMPING 02 ☐ OBSERVED (DATE: ) ☐ POTENTIAL ☐ ALLEGED

## NARRATIVE DESCRIPTION

None known or reported to date

## DESCRIPTION OF ANY OTHER KNOWN, POTENTIAL, OR ALLEGED HAZARDS

TOTAL POPULATION POTENTIALLY AFFECTED: 27,739 (3-mile radius)

## COMMENTS

## SOURCES OF INFORMATION (Cite specific references. e.g., state files, sample analysis, reports)

Report of Mine Tailings Discharge to Big River, Dr. John Novak 1980, EPA files. Preliminary Investigation on the Dynamics of Metals from Past and Present Mining Activities in the Big and Black Rivers, Southeastern Missouri, Preliminary, EPA files.



**APPENDIX B**

**Well Logs for Monitoring Wells  
Surrounding On-Site Landfill**

## APPENDIX B

### Well Logs for Monitoring Wells Surrounding On-Site Landfill

Overland Park, KS 66202

[illegible]

☐ Shop drawings     ☒ Prints     ☐ Plans     ☐ Samples     ☐ Specifications  
☐ Copy of letter     ☐ Change order     ☐ \_\_\_\_\_

[illegible]

☐ For approval                      ☐ Approved as submitted                      ☐ Resubmit \_\_\_\_\_ copies for approval  
☒ For your use                      ☐ Approved as noted                      ☐ Submit \_\_\_\_\_ copies for distribution  
☒ As requested                      ☐ Returned for corrections                      ☐ Return \_\_\_\_\_ corrected prints  
☐ For review and comment                      ☐ \_\_\_\_\_  
☐ FOR BIDS DUE \_\_\_\_\_ 19 \_\_\_\_\_ ☐ PRINTS RETURNED AFTER LOAN TO US

[illegible]

**COPY TO** \_\_\_\_\_

**SIGNED**

Dr. E. H. L. L. L.

DATE INSTALL: 1/16/87

DATE DEVELOPED: N/A - dry

782.3  
ELEV

2.75  
DEPTH

TOP OF  
RISER

PROTECTIVE COVER: 4" x 4" Steel

LOCATION: N12461 E8637

GROUND ELEVATION: 779.6 DATUM MSL

DETERMINED BY: Survey

WELL WATER LEVELS

DATE	DEPTH	REMARKS
1/21	39.1	Dry
1/21	37.1	25 Gallons added
1/21	38.6	6 Minutes later
3/11	39.1	Dry

depth measured from top of riser

RISER TYPE: flush coupled PVC

DIAMETER: 2 IN

LENGTH: 24 FT

BACKFILL: bentonite/cement grout

SEAL: bentonite pellets

SAND: medium sand (WB40)

SCREEN DIA: 2 IN LENGTH: 15 FT

TYPE: PVC

SLOT SIZE: 0.01 IN

BOREHOLE DIAMETER: 9 IN

DRILL METHOD: 4.25" HSA

760.2  
ELEV

19.4  
DEPTH

TOP OF  
SEAL

Dated ground surface

759.2  
ELEV

20.4  
DEPTH

TOP OF  
SAND

758.2  
ELEV

21.4  
DEPTH

TOP OF  
SCREEN

743.2  
ELEV

36.4  
DEPTH

BOTTOM  
OF SCREEN

742.1  
ELEV

37.5  
DEPTH

BOTTOM  
OF HOLE

REMARKS:

MONITORING WELL UG-1

GEOTECHNOLOGY  
St. Louis, Missouri

DATE INSTALL : 1/16/87  
DATE DEVELOPED: 1/21/87

786.0 2.0  
ELEV DEPTH  
TOP OF RISER

PROTECTIVE COVER: 4" x 4" Steel  
LOCATION: N11851 E9002  
GROUND ELEVATION: 784.0 DATUM: MSL  
DETERMINED BY: Survey

WELL WATER LEVELS		
DATE	DEPTH	REMARKS
1/21	46.8	
1/21	37.0	Added 36 gallons
1/21	41.4	After 5 minutes
1/21	44.3	After 20 minutes
3/11	46.3	
depth measured from top of riser		

758.0 26.0  
ELEV DEPTH  
TOP OF SEAL

below ground surface

757.0 27.0  
ELEV DEPTH  
TOP OF SAND

756.0 28.0  
ELEV DEPTH  
TOP OF SCREEN

736.0 48.0  
ELEV DEPTH  
BOTTOM OF SCREEN

735.5 48.5  
ELEV DEPTH  
BOTTOM OF HOLE

BACKFILL: bentonite/cement grout  
SEAL: bentonite pellets  
SAND: medium sand (WB40)  
SCREEN DIA: 2 IN LENGTH: 20 FT  
TYPE: PVC  
SLOT SIZE: 0.01 IN  
BOREHOLE DIAMETER: 9 IN  
DRILL METHOD: 4.25" HSA

RISER TYPE: flush coupled PVC  
DIAMETER: 2 IN  
LENGTH: 30 FT

REMARKS:

MONITORING WELL DG-1  
GEOTECHNOLOGY  
St. Louis, Missouri

DATE INSTAL 1/13/87

DATE DEVELOPED: 1/20/87

796.2

ELEV

2.1

DEPTH

TOP OF  
RISER

PROTECTIVE COVER: 4" x 4" Steel

LOCATION: N10707 E9781

GROUND ELEVATION: 794.1 DATUM MSL

DETERMINED BY: Survey

## WELL WATER LEVELS

DATE	DEPTH	REMARKS
1/16	24.9	Before development
1/20	24.5	After development
3/11	23.3	

depth measured from top of riser

RISER TYPE: flush coupled PVC

DIAMETER: 2 IN

LENGTH: 6.6 FT

BACKFILL: bentonite/cement grout

SEAL: bentonite pellets

791.6

ELEV

2.5

DEPTH

TOP OF  
SEAL

Below ground surface

790.6

ELEV

3.5

DEPTH

TOP OF  
SAND

789.6

ELEV

4.5

DEPTH

TOP OF  
SCREEN

SAND: medium sand (WB40)

SCREEN DIA: 2 IN LENGTH: 25 FT  
TYPE: PVC

SLOT SIZE: 0.01 IN

764.6

ELEV

29.5

DEPTH

BOTTOM  
OF SCREEN

763.6

ELEV

29.5

DEPTH

BOTTOM  
OF HOLE

BOREHOLE DIAMETER: 9 IN

DRILL METHOD: 4.25" HSA

REMARKS:

MONITORING WELL DG-2

GEOTECHNOLOGY

St. Louis, Missouri

DATE INSTALLED 1/13/87DATE DEVELOPED: N/A - Dry785.8  
ELEV2.1  
DEPTHTOP OF  
RISERPROTECTIVE COVER: 4" x 4" SteelLOCATION: N9746 E8892GROUND ELEVATION: 783.7 DATUM: MSLDETERMINED BY: Survey

## WELL WATER LEVELS

DATE	DEPTH	REMARKS
1/16	44.1	
1/20	44.1	20 Gallons added
1/21	44.6	10 Gallons added

depth measured from top of riser

RISER TYPE: flush coupled PVCDIAMETER: 2 INLENGTH: 30 FTBACKFILL: bentonite/cement groutSEAL: bentonite pellets757.7  
ELEV26.0  
DEPTHTOP OF  
SEAL

below ground surface

756.7  
ELEV27.0  
DEPTHTOP OF  
SAND755.7  
ELEV28.0  
DEPTHTOP OF  
SCREENSAND: medium sand (WB40)SCREEN DIA: 2 IN LENGTH: 15 FT  
TYPE: PVCSLOT SIZE: 0.01 IN740.7  
ELEV43.0  
DEPTHBOTTOM  
OF SCREENBOREHOLE DIAMETER: 9 IN738.7  
ELEV45.0  
DEPTHBOTTOM  
OF HOLEDRILL METHOD: 4.25" HSA

REMARKS:

MONITORING WELL DG-3

GEOTECHNOLOGY  
St. Louis, Missouri

DATE INSTAL 1/19/87DATE DEVELOPED: N/A - Dry770.2

ELEV

2.0

DEPTH

TOP OF  
RISERPROTECTIVE COVER: 4" x 4" SteelLOCATION: N10934 E8137GROUND ELEVATION: 768.2 DATUM MSLDETERMINED BY: Survey

## WELL WATER LEVELS

DATE	DEPTH	REMARKS
<u>1/21</u>	<u>28.3</u>	
<u>1/21</u>	<u>26.3</u>	<u>After 22 gallons</u>
<u>1/21</u>	<u>27.2</u>	<u>6 Minutes later</u>

depth measured from top of riser

RISER TYPE: flush coupled PVCDIAMETER: 2 INLENGTH: 21 FTBACKFILL: bentonite/cement groutSEAL: bentonite pellets752.5

ELEV

15.7

DEPTH

TOP OF  
SEAL

below ground surface

751.5

ELEV

16.7

DEPTH

TOP OF  
SAND749.2

ELEV

19.0

DEPTH

TOP OF  
SCREENSAND: medium sand (WB40)SCREEN DIA: 2 IN LENGTH: 10 FT  
TYPE: PVCSLOT SIZE: 0.01 IN739.2

ELEV

29.0

DEPTH

BOTTOM  
OF SCREEN739.2

ELEV

29.0

DEPTH

BOTTOM  
OF HOLEBOREHOLE DIAMETER: 9 INDRILL METHOD: 4.25" HSA

REMARKS: \_\_\_\_\_

MONITORING WELL DG-4

GEOTECHNOLOGY  
St Louis, Missouri



DATE INSTALL: 1/19/87

DATE DEVELOPED: 1/19/87

683.1  
ELEV

1.1  
DEPTH

TOP OF  
RISER

PROTECTIVE COVER: 4" x 4" Steel

LOCATION: N12069 E9185

GROUND ELEVATION: 682 DATUM: MSL

DETERMINED BY: Survey

WELL WATER LEVELS		
DATE	DEPTH	REMARKS
1/19	6.0	After installation
1/19	7.0	After development
depth measured from top of riser		

RISER TYPE: flush coupled PVC

DIAMETER: 2 IN

LENGTH: 6.2 FT

BACKFILL:  

SEAL: cement

SAND: natural sand

SCREEN DIA: 2 IN LENGTH: 5 FT

TYPE: PVC

SLOT SIZE: 0.01 IN

BOREHOLE DIAMETER: 4 IN

DRILL METHOD: 4" hand auger and casing

682.0  
ELEV

0  
DEPTH

TOP OF  
SEAL

below ground surface

679.0  
ELEV

3.0  
DEPTH

TOP OF  
SAND

671.9  
ELEV

5.1  
DEPTH

TOP OF  
SCREEN

671.9  
ELEV

10.1  
DEPTH

BOTTOM  
OF SCREEN

671.6  
ELEV

10.4  
DEPTH

BOTTOM  
OF HOLE

REMARKS:  

MONITORING WELL DG-5

GEOTECHNOLOGY  
St. Louis, Missouri

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

Surface Elevation <u>780</u> Datum <u>MSL</u>		Completion Date <u>01/16/87</u>		SHEAR STRENGTH, 1sf △ - uu/2    ○ - qu/2    ◇ - sv 0.5    1.0    1.5    2.0    2.5		
DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WEIGHT SPT VALUE	SAMPLES	STANDARD PENETRATION RESISTANCE (ASTM D 1586) △ - BLOWS PER FOOT WATER CONTENT, % PL 10 20 30 40 50 LL		
				10	Tan to gray, very loose to loose slightly silty fine SAND becoming gray and more silty below 14 feet	
SS	△					
SS	△	○	Grain Size Analysis			
SS	△					
20	Intermixed gray, loose to medium dense, silty clayey SAND, to sandy clayey SILT		SS	△	○	Grain Size Analysis
SS			△			
SS			△	○	Grain Size Analysis	
SS			△	○	Grain Size Analysis	
30	Auger refusal on SANDY DOLOMITE at 37.5 feet					
40						
50						
60						
70						

#### GROUNDWATER DATA

#### DRILLING DATA

ENCOUNTERED AT 23.5 FEET  
 AT \_\_\_\_\_ FEET AFTER \_\_\_\_\_ HOURS  
 AT \_\_\_\_\_ FEET AFTER \_\_\_\_\_ HOURS  
 FREE WATER NOT ENCOUNTERED DURING DRILLING  
 AUGER 9" HOLLOW STEM  
 WASH BORING FROM \_\_\_\_\_ FEET  
 MM DRILLER KDD LOGGER  
 CME SS DRILL RIG

### LOG OF BORING

UG-1

REMARKS: PVC monitoring well casing installed

GEOTECHNOLOGY

St. Louis, Missouri

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

Surface Elevation 784Datum MSLCompletion Date 01/16/87DEPTH  
IN FEET

## DESCRIPTION OF MATERIAL

UNIT DRY WEIGHT  
SPT VALUE

SAMPLES

SHEAR STRENGTH, 1sf

 $\Delta$  -  $UU/2$  $\circ$  -  $QU/2$  $\diamond$  -  $SV$ 

0.5

1.0

1.5

2.0

2.5

STANDARD PENETRATION RESISTANCE  
(ASTM D 1586) $\Delta$  - BLOWS PER FOOT

WATER CONTENT, %

PL

10

20

30

40

50

LL

Tan. loose to medium dense. fine SAND  
with zones of gray clay up to 3"

SS

 $\Delta$ 

SS

 $\Delta$ 

SS

 $\Delta$ 

SS

 $\Delta$ 

SS

 $\Delta$ 

SS

 $\Delta$ 

SS

 $\Delta$  $\circ$ Grain Size  
Analysis

SS

 $\Delta$ 

SS

 $\Delta$ 

SS

 $\Delta$ 

SS

 $\Delta$ 

SS

 $\Delta$ 

SS

 $\Delta$  $\circ$ Grain Size  
Analysis

SS

 $\Delta$ 

SS

 $\Delta$ 

SS

 $\Delta$ Gray. very loose. sandy and clayey  
SILT with green and black organics  
at 99 feet

## GROUNDWATER DATA

## DRILLING DATA

ENCOUNTERED AT 34 FEETAUGER 9" HOLLOW STEMAT        FEET AFTER        HOURSWASH BORING FROM        FEETAT        FEET AFTER        HOURSMM DRILLER KDO LOGGERFREE WATER NOT ENCOUNTERED  
DURING DRILLINGCME SS DRILL RIGREMARKS: PVC monitoring well casing installed

LOG OF BORING

DG-1

GEOTECHNOLOGY

St. Louis, Missouri

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES  
BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

CONTINUATION OF BORING DG-1		SURFACE ELEVATION 784		SHEAR STRENGTH, 1sf $\Delta$ - $UU/2$ $\circ$ - $QU/2$ $\diamond$ - $SV$ 0.5    1.0    1.5    2.0    2.5			
DEPTH IN FEET		DESCRIPTION OF MATERIAL	UNIT DRY WEIGHT SPT VALUE	SAMPLES	STANDARD PENETRATION RESISTANCE (ASTM D 1586) $\Delta$ - BLOWS PER FOOT WATER CONTENT, % PL ——— LL		
					10	20	30
		Gray, very loose, sandy and clayey SILT with green and black organics at 99 feet		SS	$\Delta$		
90				SS	$\Delta$	$\circ$	Grain Size Analysis
				SS	$\Delta$		
100		TERMINATED AT 100' DUE TO INSTABILITY OF TAILINGS		SS	$\Delta$		
110							
120							
130							
140							
150							
160							
170							

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

GEOTECHNOLOGY  
St. Louis, Missouri

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

Surface Elevation <u>794</u> Datum <u>MSL</u>		Completion Date <u>01/13/87</u>		SHEAR STRENGTH, 1sf $\Delta$ -uu/2 $\circ$ -qu/2 $\diamond$ -sv 0.5    1.0    1.5    2.0    2.5		
DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WEIGHT SPT VALUE	SAMPLES	STANDARD PENETRATION RESISTANCE (ASTM D 1586) $\Delta$ - BLOWS PER FOOT WATER CONTENT, % PL ————— LLL 10    20    30    40    50		
	Gray, loose, SAND with zones of silty to clayey SAND		SS	$\Delta$		Grain Size Analysis
-10		SS	$\Delta$	$\circ$		
	Gray, very loose, sandy to slightly clayey SILT		SS	$\Delta$		Grain Size Analysis
-20		SS	$\Delta$			
	Medium stiff, dark brown and gray, silty CLAY		SS	$\Delta$	H O	Grain Size Analysis
-30		SS	$\Delta$			
	Split spoon refusal on SANDY DOLOMITE at 30.5 feet		SS	$\Delta$		$\Delta$ S-6"
-40		SS				
-50						
-60						
-70						

#### GROUNDWATER DATA

ENCOUNTERED AT 13.5 FEET  
AT \_\_\_\_\_ FEET AFTER \_\_\_\_\_ HOURS  
AT \_\_\_\_\_ FEET AFTER \_\_\_\_\_ HOURS  
FREE WATER NOT ENCOUNTERED DURING DRILLING

#### DRILLING DATA

AUGER 9" HOLLOW STEM  
WASH BORING FROM \_\_\_\_\_ FEET  
MM DRILLER KDD LOGGER  
CME SS DRILL RIG

#### LOG OF BORING

REMARKS: PVC monitoring well casing installed

DG-2

GEOTECHNOLOGY

St. Louis, Missouri

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

Surface Elevation <u>784</u> Datum <u>MSL</u>		Completion Date <u>01/13/87</u>		SHEAR STRENGTH, 1sf Δ-uw/2    O-qu/2    ◇-sv 0.5    1.0    1.5    2.0    2.5	
DESCRIPTION OF MATERIAL		UNIT DRY WEIGHT	SPT VALUE	STANDARD PENETRATION RESISTANCE (ASTM D 1586) Δ - BLOWS PER FOOT WATER CONTENT, % PL 10 20 30 40 50 60 70 80 90 100	
DEPTH IN FEET				Grain Size Analysis.	
0	Tan, loose to medium dense, fine to medium, SILT and silty SAND				
10					
20					
30					
40					
40	Brown gray, loose, fine gravelly SAND with wood and black organics				Grain Size Analysis.
50	Brown, medium stiff, silty CLAY with sandy DOLOMITE fragments				Grain Size Analysis.
50	Boring terminated at 45 feet				Grain Size Analysis.
60					
70					

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES  
BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

## GROUNDWATER DATA

ENCOUNTERED AT 33 FEET  
AT        FEET AFTER        HOURS  
AT        FEET AFTER        HOURS  
FREE WATER NOT ENCOUNTERED  
DURING DRILLING

## DRILLING DATA

AUGER 9" HOLLOW STEM  
WASH BORING FROM        FEET  
MM DRILLER KDO LOGGER  
CME SS DRILL RIG

REMARKS: PVC monitoring well casing installed

LOG OF BORING

DG-3

GEOTECHNOLOGY

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

St. Louis, Missouri

Surface Elevation 768Datum MSLCompletion Date 01/19/87DEPTH  
IN FEET

## DESCRIPTION OF MATERIAL

UNIT DRY WEIGHT  
SPT VALUE

SAMPLES

SHEAR STRENGTH,  $\text{tsf}$  $\Delta - \text{uu}/2$  $\circ - \text{qu}/2$  $\diamond - \text{sv}$ 

0.5

1.0

1.5

2.0

2.5

STANDARD PENETRATION RESISTANCE  
(ASTM D 1586) $\Delta$  - BLOWS PER FOOT

WATER CONTENT, %

PL

10

20

30

40

50

LL

Tan. loose to medium dense SAND

SS

 $\Delta$ 

SS

 $\circ$  $\Delta$ Grain Size  
Analysis

SS

 $\Delta$ 

SS

 $\Delta$ Grain Size  
Analysis

SS

 $\circ$  $\Delta$ 

5-8"

Brown silty CLAY with dolomite  
fragments

Split spoon refusal at 29 feet

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES  
BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

## GROUNDWATER DATA

## DRILLING DATA

ENCOUNTERED AT 24 FEET \_\_\_\_\_ AUGER 9" HOLLOW STEM

AT \_\_\_\_\_ FEET AFTER \_\_\_\_\_ HOURS \_\_\_\_\_ WASH BORING FROM \_\_\_\_\_ FEET

AT \_\_\_\_\_ FEET AFTER \_\_\_\_\_ HOURS \_\_\_\_\_ MM DRILLER KDO LOGGERFREE WATER: NOT ENCOUNTERED \_\_\_\_\_ CME SS DRILL RIGREMARKS: PVC monitoring well casing installed

LOG OF BORING

DG-4

GEOTECHNOLOGY

St. Louis, Missouri

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

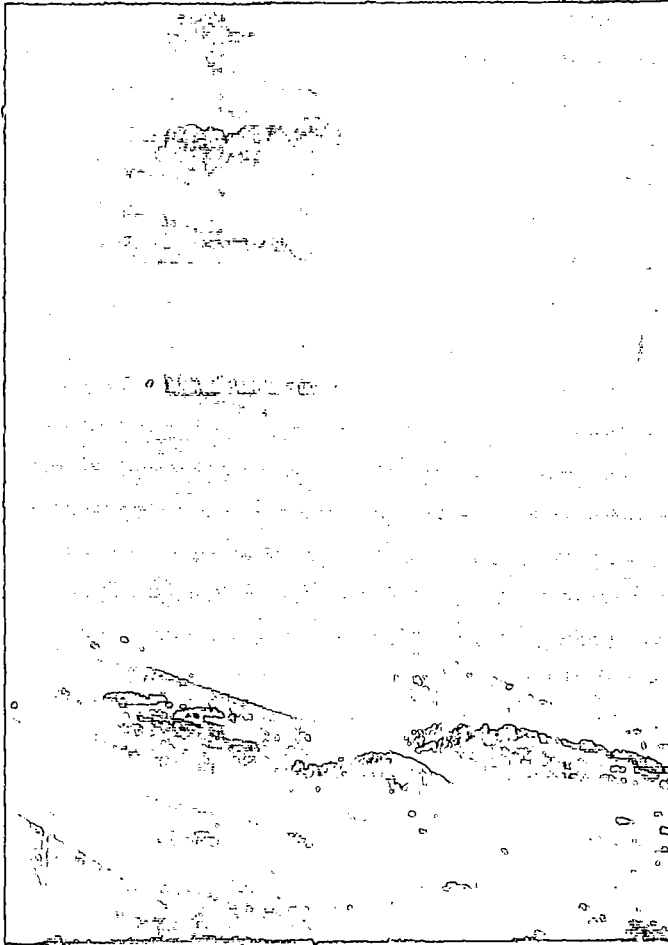
APPENDIX C

Photo Documentation of Site



ECOLOGY & ENVIRONMENT, INC.  
PHOTOGRAPHIC RECORD

SITE



No.: C-1

Subject Big River with mine tailing dust  
rising from the pile.

Photographer

Robert Overfelt

Witness

Gene Gunn

Date/Time

January 25, 1988 1030 hrs

Direction

North

No.: C-2

Subject

Area where mine  
tailings slope  
are in contact  
with the Big River

Photographer

Robert Overfelt

Witness

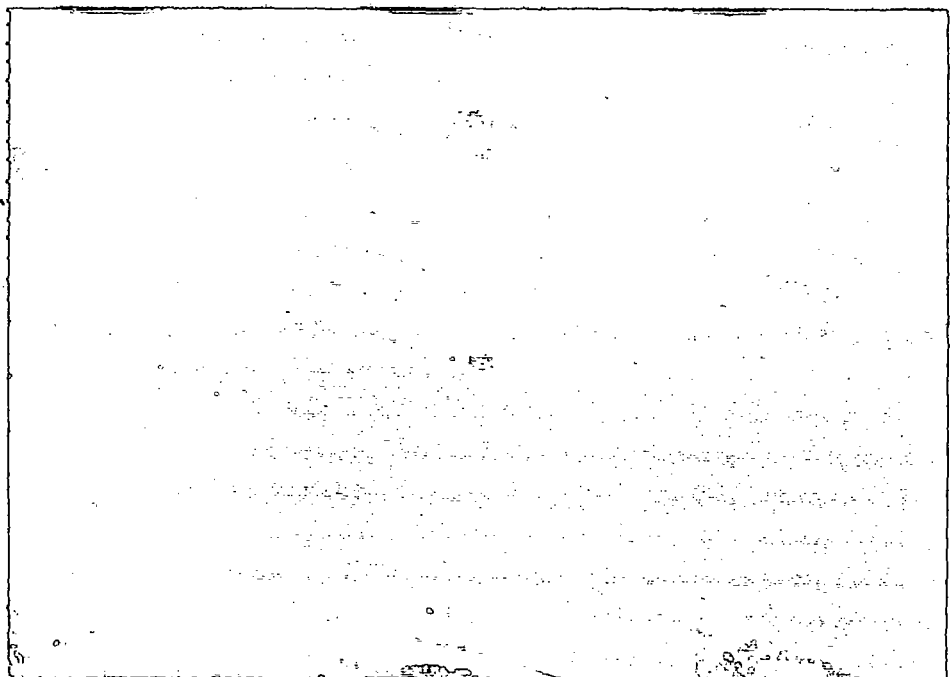
Gene Gunn

Date/Time

January 25, 1988  
1030 hrs

Direction

North



ECOLOGY & ENVIRONMENT, INC.  
PHOTOGRAPHIC RECORD

SITE

No.: C-3

Subject

Gap A from edge  
of River after  
filled

Photographer

Bob Overfelt

Witness

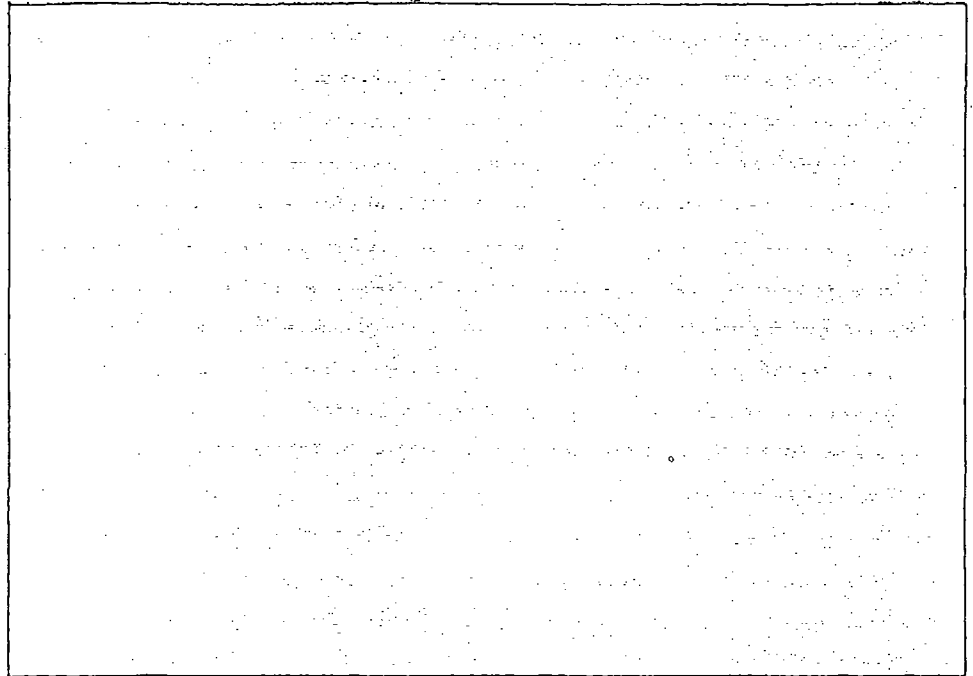
Gene Gunn

Date/Time

January 25, 1988

Direction

West



No.: C-4

Subject

Wind fencing  
Box configuration

Photographer

Bob Overfelt

Witness

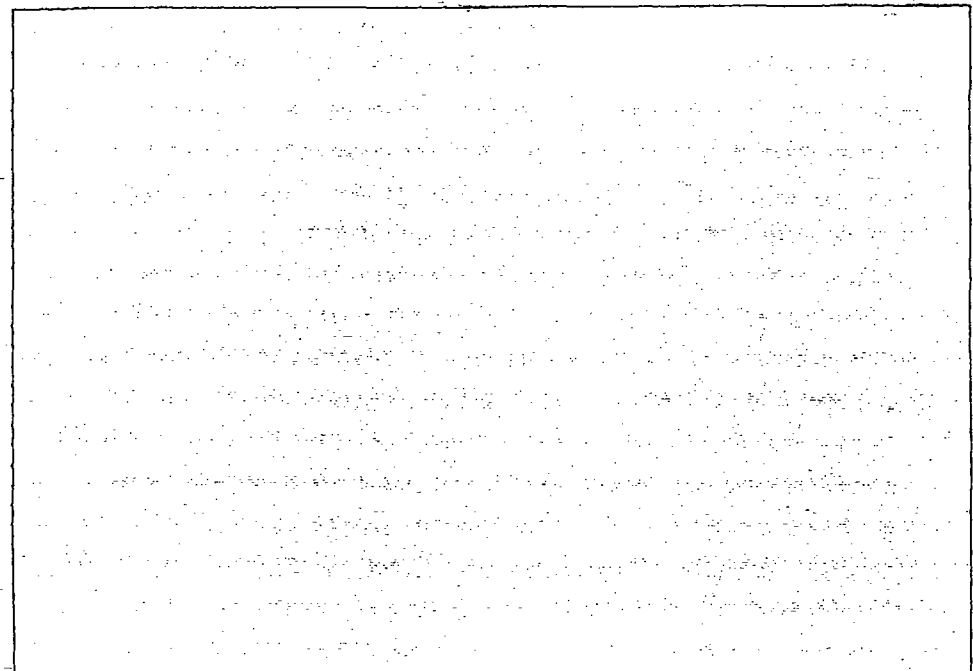
Gene Gunn

Date/Time

January 25, 1988

Direction

Southeast



ECOLOGY & ENVIRONMENT, INC.  
PHOTOGRAPHIC RECORD

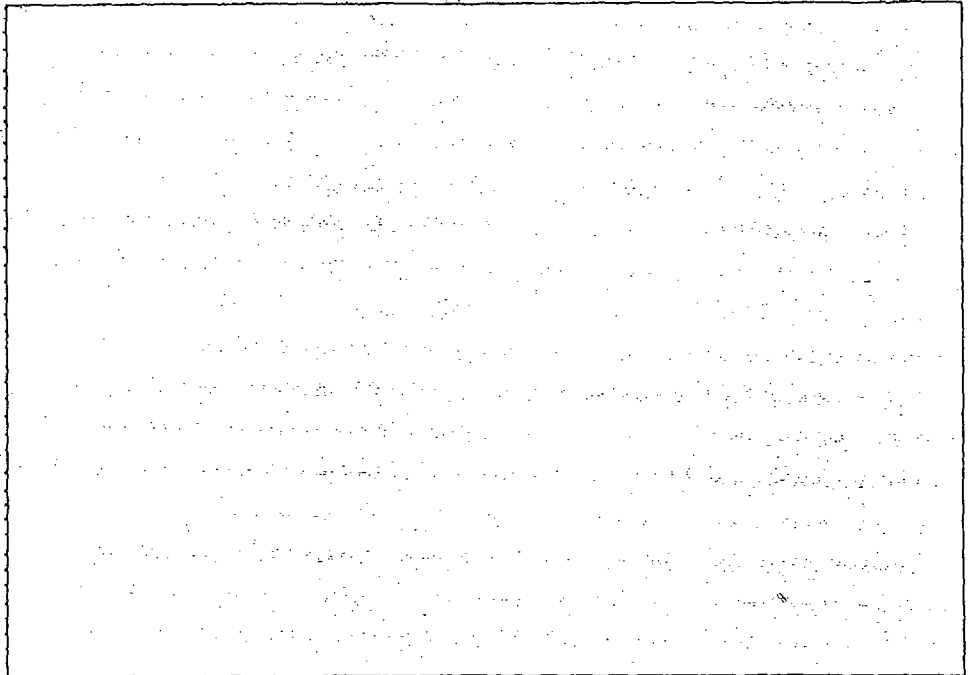
SITE

No.: C-5  
Subject Wind

Fencing showing tail-  
ings accumulation.

Photographer  
Bob Overfelt  
Witness  
Gene Gunn

Date/Time  
January 25, 1988  
1100 hrs  
Direction  
Southwest

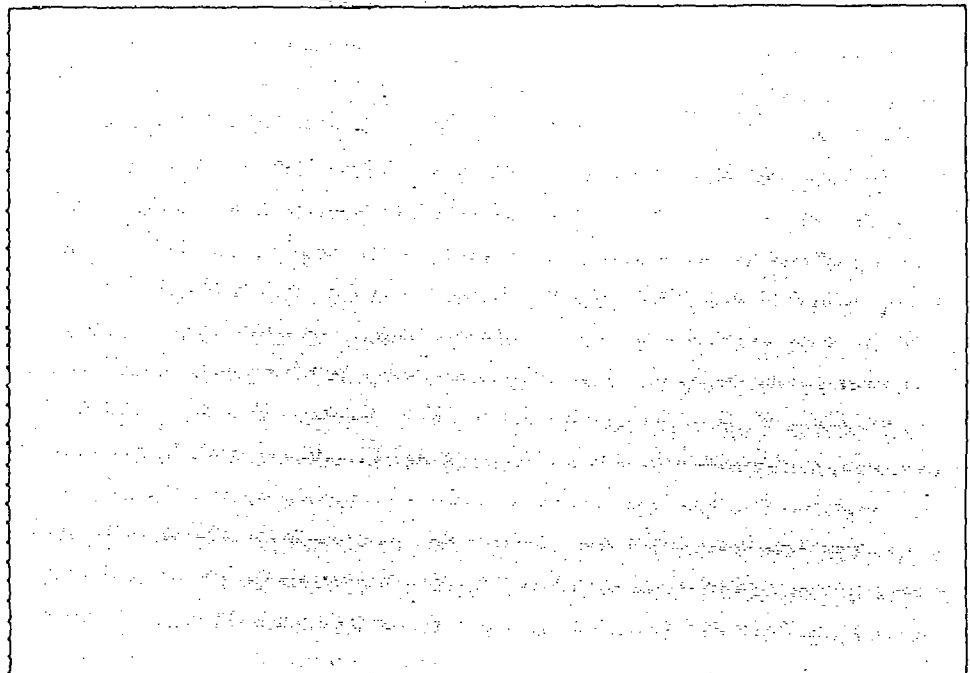


No.: C-6  
Subject Trees

Planted on north  
side.

Photographer  
Bob Overfelt  
Witness  
Gene Gunn

Date/Time  
January 25, 1988  
1100 hrs  
Direction  
West



ECOLOGY & ENVIRONMENT, INC.  
PHOTOGRAPHIC RECORD

SITE

No.: C-7

Subject

Trees planted on  
north side.

Photographer

Bob Overfelt

Witness

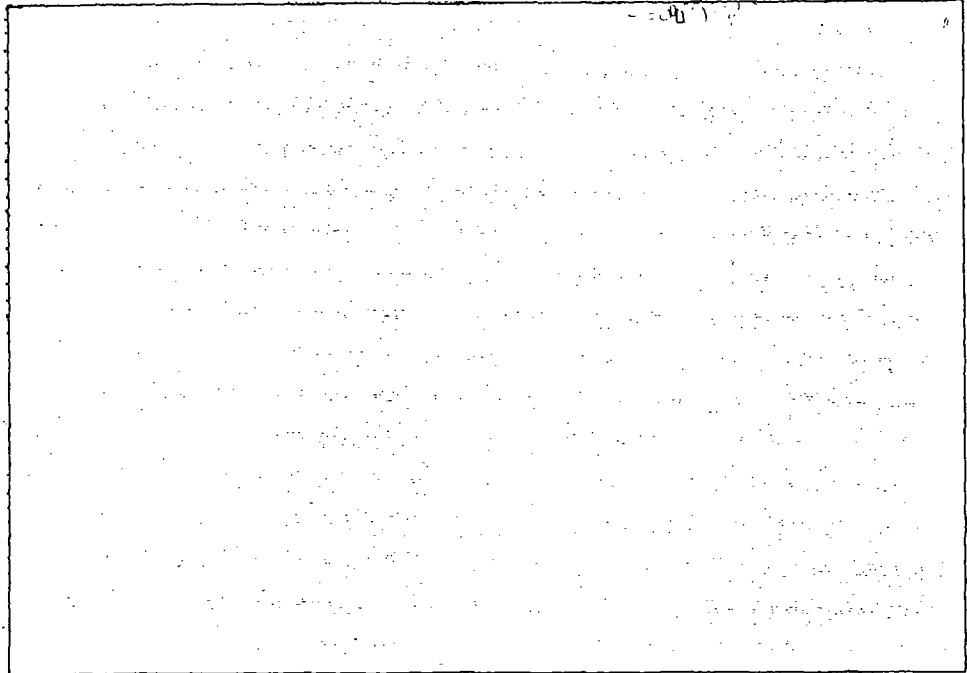
Gene Gunn

Date/Time

January 25, 1988

1100 hrs  
Direction

Southwest



No.: C-8

Subject

"H" Gap filled

Photographer

Bob Overfelt

Witness

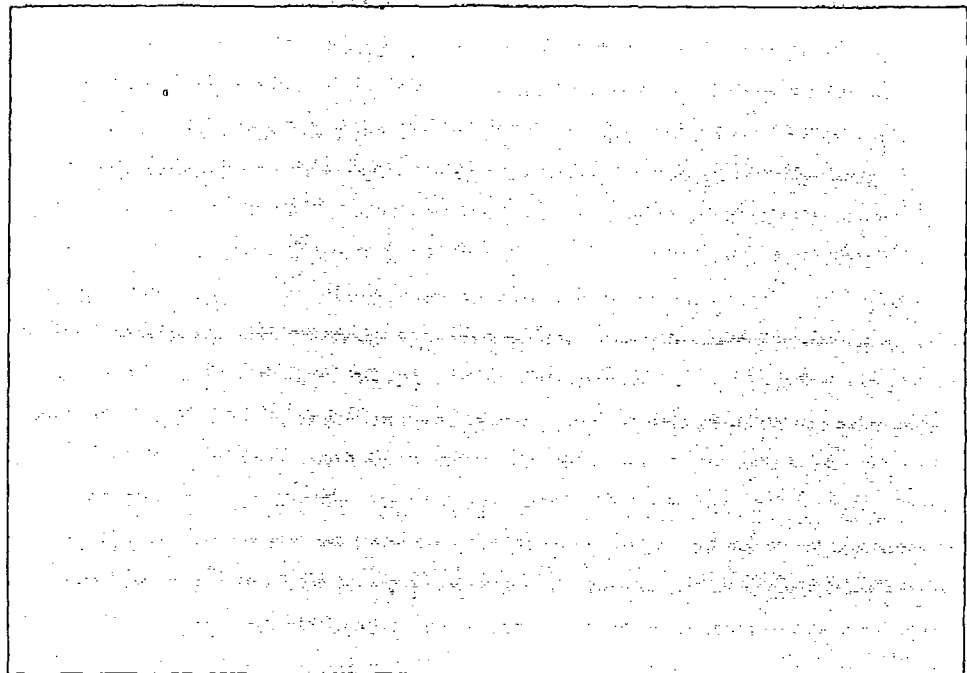
Gene Gunn

Date/Time

January 25, 1988

1120 hrs  
Direction

Northeast



ECOLOGY & ENVIRONMENT, INC.  
PHOTOGRAPHIC RECORD

SITE

No.: C-9

Subject

Trees & grass planted  
on west side of pile  
near gap I

Photographer

Bob Overfelt

Witness

Gene Gunn

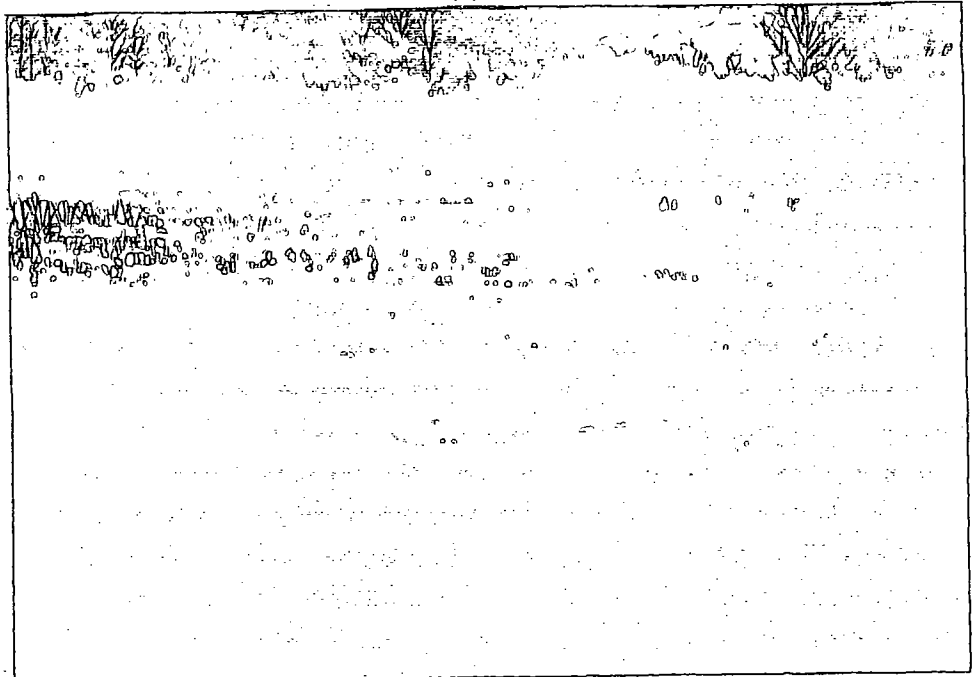
Date/Time

January 25, 1988

1130 hrs

Direction

Northeast



No.: C-10

Subject

Berm with Gap "I"  
drainage pipe.

Photographer

Bob Overfelt

Witness

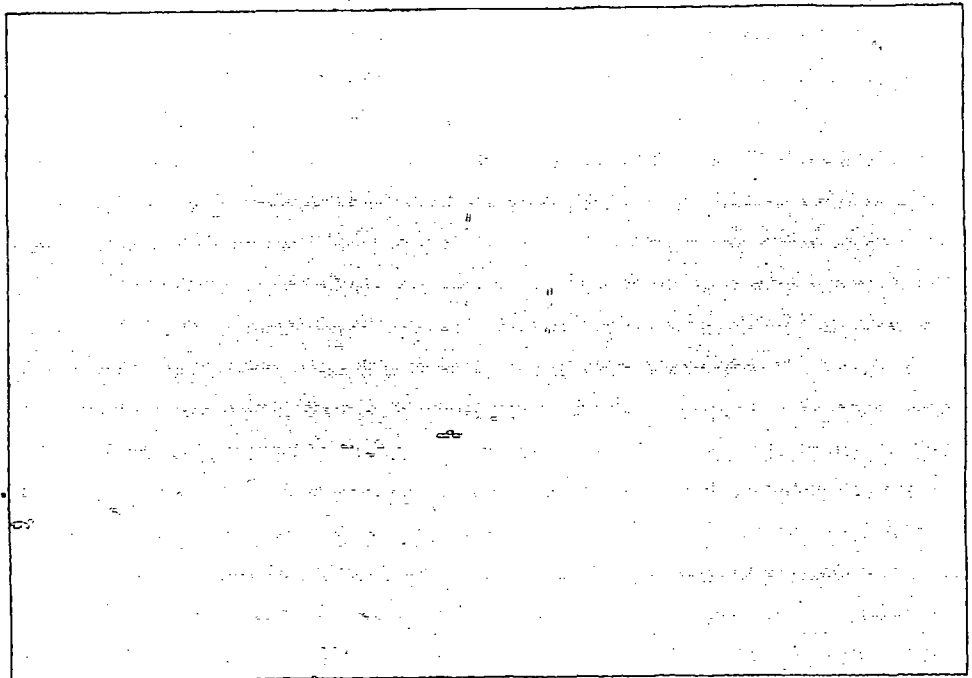
Gene Gunn

Date/Time

January 25, 1988 1200 hrs.

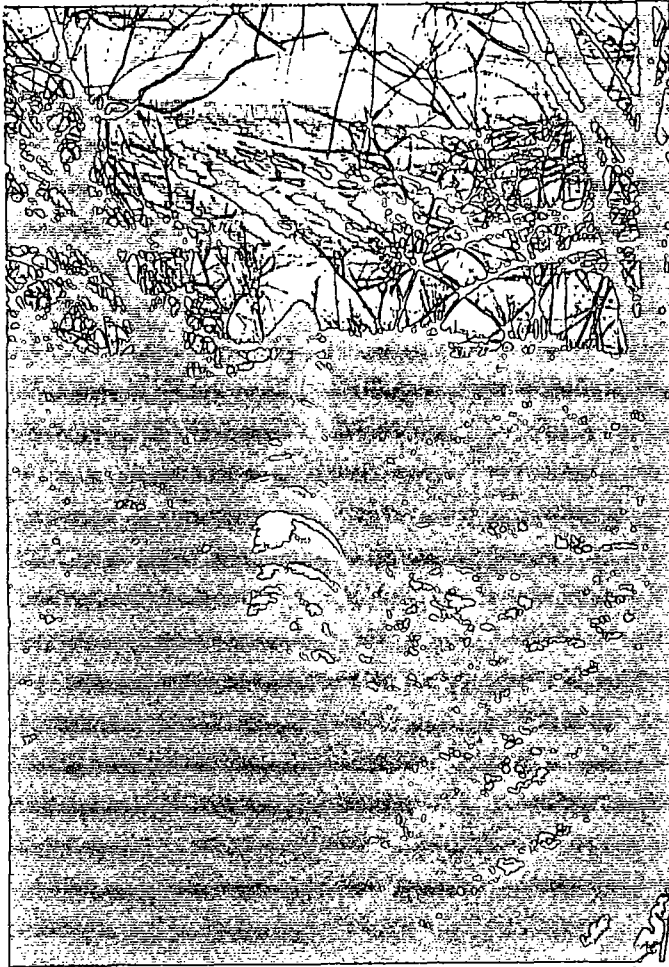
Direction

North



ECOLOGY & ENVIRONMENT, INC.  
PHOTOGRAPHIC RECORD

SITE



No.: C-11

Subject Gap "I" drainage pipe from  
Big River.

Photographer

Bob Overfelt

Witness

Gene Gunn

Date/Time

January 25, 1988 1230 hrs.

Direction

East

No.: C-12

Subject

West side where tailings  
meet river.

Photographer

Bob Overfelt

Witness

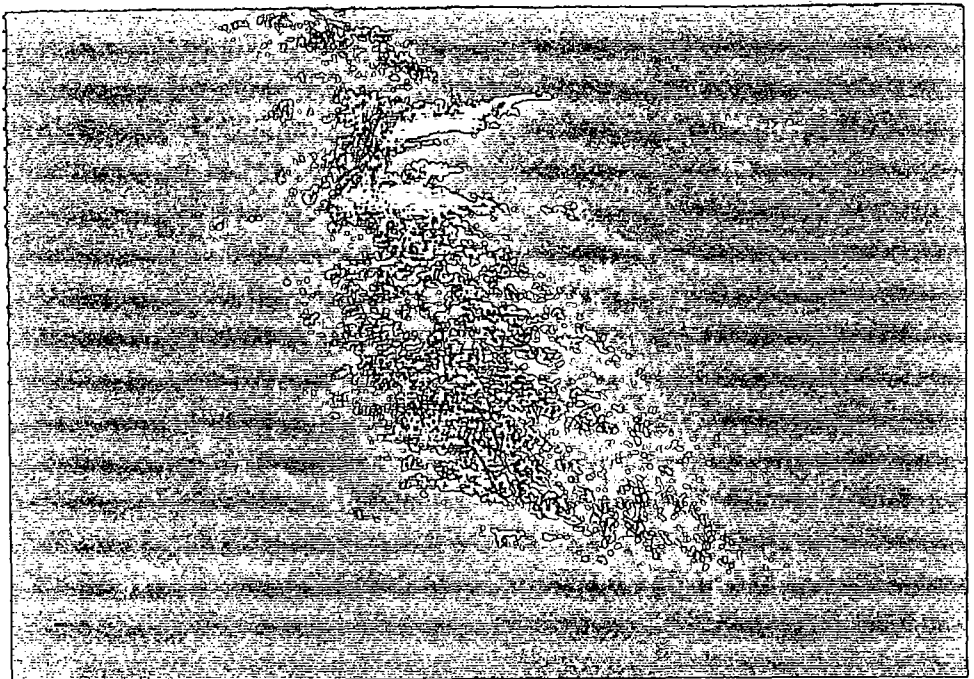
Gene Gunn

Date/Time

January 25, 1988 1245 hrs.

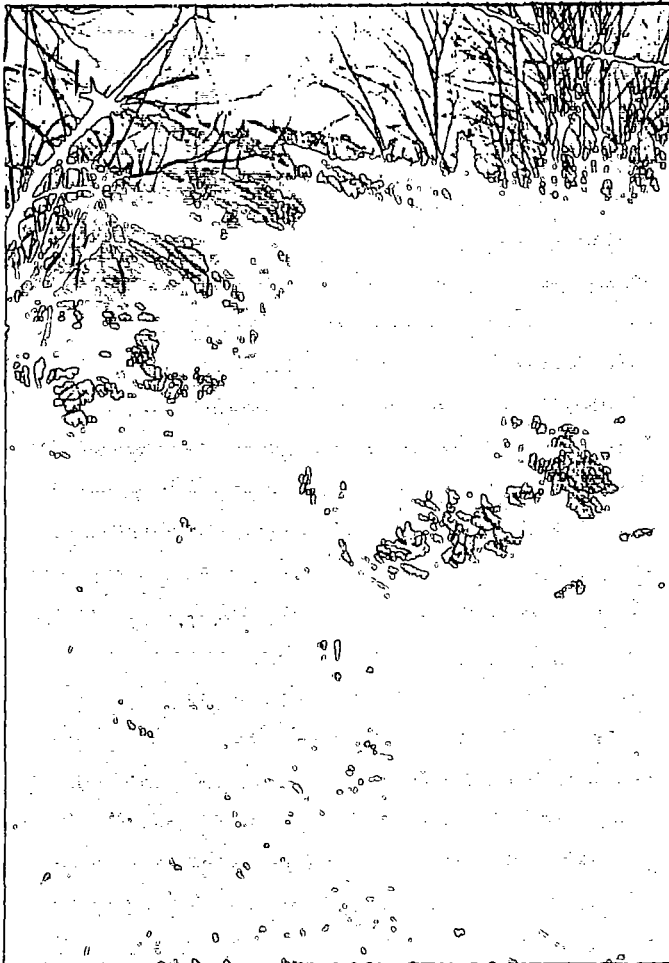
Direction

Southwest



ECOLOGY & ENVIRONMENT, INC.  
PHOTOGRAPHIC RECORD

SITE



No.: C-13

Subject

Cut back of river where tailings  
meet river.

Photographer

Bob Overfelt

Witness

Gene Gunn

Date/Time

January 25, 1988 1250 hrs.

Direction

Southeast

No.: C-14

Subject

Original drainage  
structure.

Photographer

Bob Overfelt

Witness

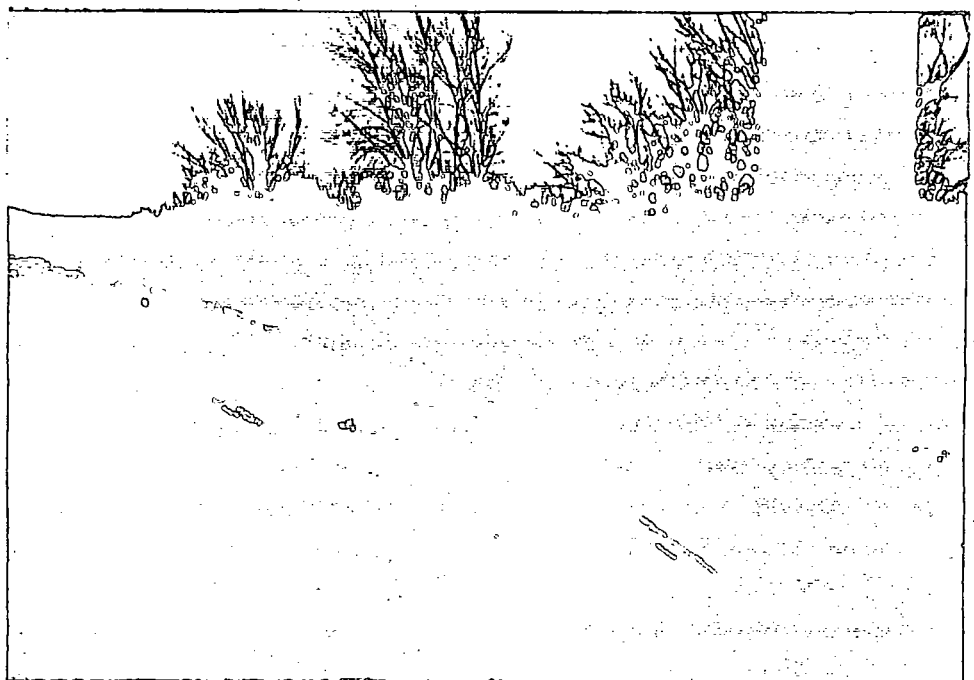
Gene Gunn

Date/Time

January 25, 1988 1300 hrs.

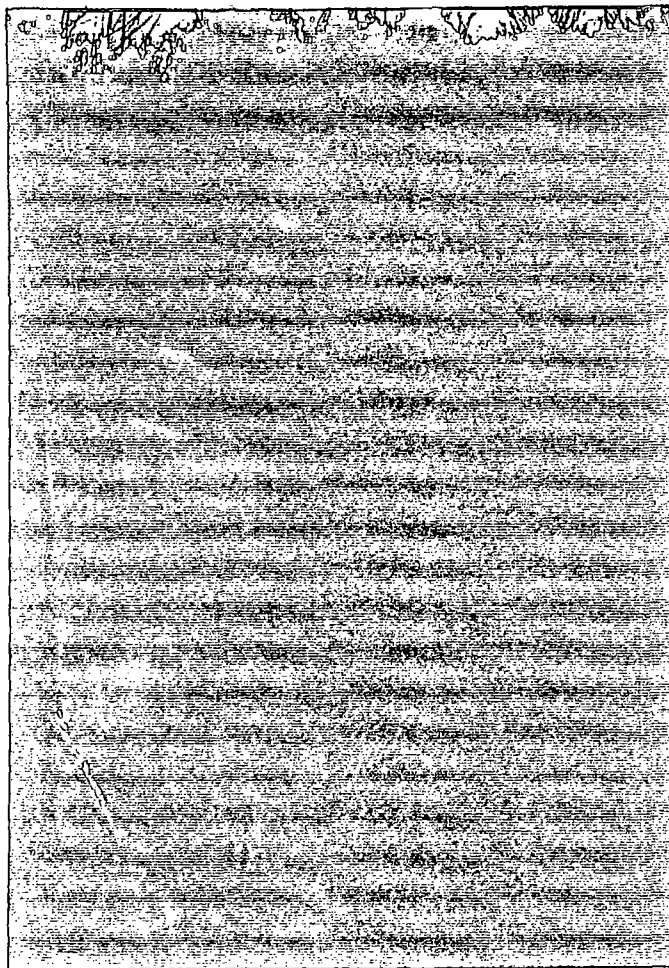
Direction

Southwest



ECOLOGY & ENVIRONMENT, INC.  
PHOTOGRAPHIC RECORD

SITE



No.: C-15

Subject

Gap "E" showing tailings and  
bedrock.

Photographer

Bob Overfelt

Witness

Gene Gunn

Date/Time

January 25, 1988 1320 hrs.

Direction

Southeast

No.: C-16

Subject

Gap "E" draining tail-  
ings toward river.

Photographer

Bob Overfelt

Witness

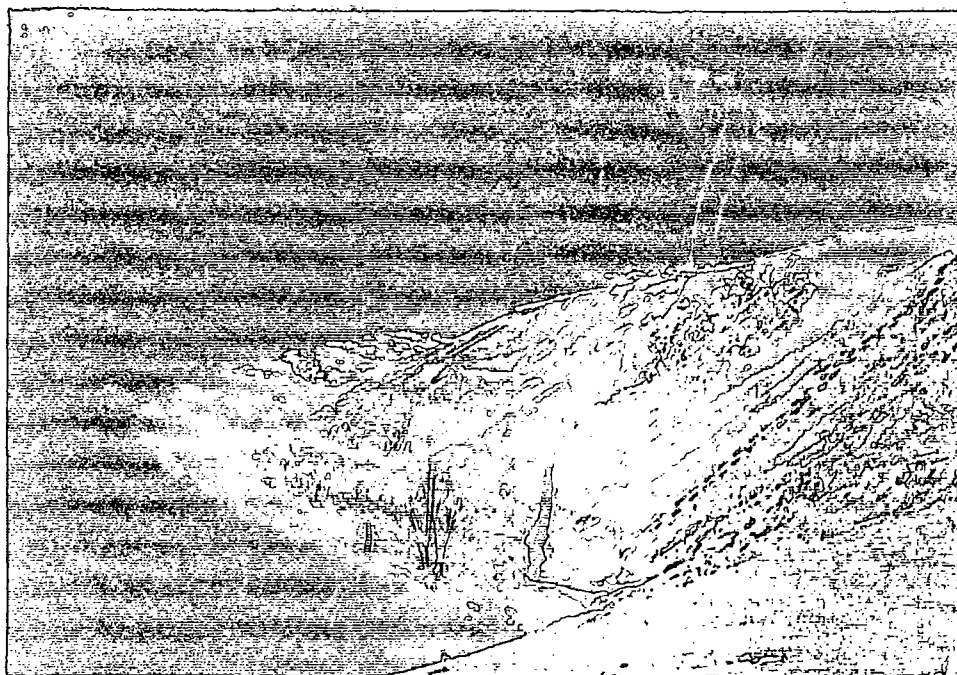
Gene Gunn

Date/Time

January 25, 1988 1325 hrs.

Direction

West





ECOLOGY & ENVIRONMENT, INC.  
PHOTOGRAPHIC RECORD

SITE

No.: C-17

Subject

Dam above Gap "E"

Photographer

Bob Overfelt

Witness

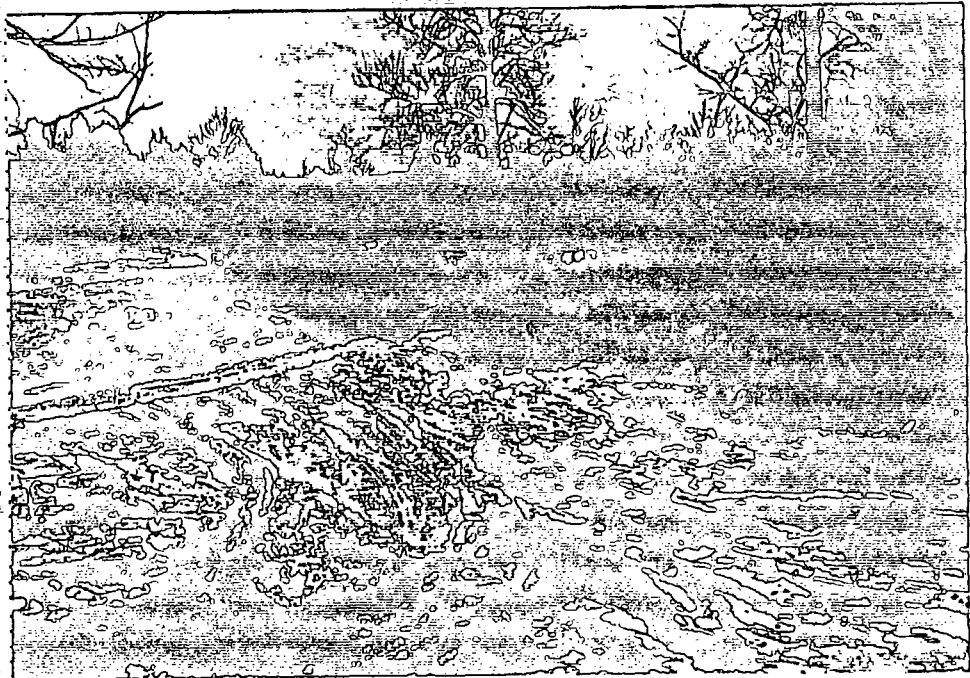
Gene Gunn

Date/Time

January 25, 1988 1330 hrs.

Direction

Southwest



No.:

Subject

Photographer

END OF PHOTOGRAPHIC RECORD

Witness

Date/Time

Direction

**APPENDIX D**

**Sample Results Heavy Metals in  
Desloge Tailings Pile**

CONCENTRATIONS OF LEAD, CADMIUM, AND ZINC FROM SAMPLES  
TAKEN AT THE BIG RIVER-DESLOGE TAILINGS PILE

Sample No.	Metal Conc; ug/g		
	Pb	Cd	Zn
D900	1670	37.8	1670
D901	1540	38.9	1700
D902	1420	27.4	1150
D903	1190	11.7	330
D904	1420	54.8	2380
D905	2590	30.2	1320
D906	3840	34.9	1750
D907	3560	26.5	1380
D908	970	6.8	875
D909	1250	15.6	950
D910	1800	15.7	1040
D911	1360	25	1080
D912	2310	40.0	1890
D913	4470	18.3	821
D915	1530	13.8	680
D916	826	15.7	531
D917	3140	31.7	1440
D918	1020	17.4	637
D919	958	21.4	798
D920	2710	29.9	1380
D921	1570	8.0	511
D922	997	7.0	406
D923	835	8.0	373
D924	896	7.5	437
D925	1310	9.8	373
D926	1080	13	297
D927	983	11.8	354
D928	877	16.5	518
D929	964	13.8	373
D930	1380	15.0	582
D931	1010	18.5	698
D932	1150	21.5	816
D933	951	11.6	233
D934	1620	20.5	840
D935	5530	46.9	404
D936	1570	24.2	933
D937	1400	8.7	525
D938	1330	19.8	733
D939	1140	21.5	783
D940	2380	19.2	1380
D941	1120	9.2	558
D942	1410	15.4	715
D943	4320	68.2	3580
D944	1800	15.8	1210
D945	1710	21.1	1090

Sample	Metal Conc.: ug/g		
	No.	Pb	Cd Zn
D946	3190	17.5	1350
D947	933	12.0	344
D948	1440	13.5	439
D949	2380	18.1	644
D950	1730	15.9	693
D951	1540	55.9	519
D952	1490	7.7	560
D953	1070	24.5	1030
D954	4710	31.4	1510
D955	2780	30.7	1570
D956	5360	28.8	1330
D957	6200	37.3	1720
D958	2910	37.1	1680
D960	1880	35.8	3990
D961	1830	39.4	3080
D962	1950	38.9	2910
D963	1410	32.9	1970
D964	2180	45.6	2500
D965	2130	43.8	1780
D967	1980	37.8	1720
D968	2310	37.9	1870
D969	1810	25.6	1100
D970	3610	38.2	1850
D971	5822	46.2	2250
D972	2240	22.9	994
D973	4070	44.5	2090
D974	2110	33.6	1560
D975	3130	51.6	2410
D976	2690	78.6	3970